SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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Original Correspondence.

THE MANUFACTURING INDUSTRY OF SCOTLAND.

THE THREAD WORKS OF PAISLEY.

The town of Paisley, long famous for its bright and many coloured shawls, is now known as the home of thread manufacture in the United Kingdom, this particular industry having developed and centralised in the quaint old town, just as the manufacture of lace has become the distinctive industry of Nottingham, and Sheffield has acquired a name for its cutlery. The two principal firms in Paisley are Messrs. J. and J. Clark, and Messrs. J. and P. Coats. In their own trade each of these firms has obtained a world-wide reputation. They are known in every domestic circle; their products are to be found by every hearth. In America and on the Continent, as well as throughout the United Kingdom, they carry on a large business; and as their ramifications are so extensive, and their products in such universal use, no apology can be necessary for bringing their names, in connection with a description of their works, before our readers.

Messrs. J. and J. Clark claim, by reason of seniority, the right to be first noticed. The works are known by the name of the Anchor Factory—an anchor being the trade mark of the firm—and consist of four large mills, each separate from the other, and erected at different periods to meet the requirements of their increasing business. Distinguishing names have been given to each of the mills, and they are so arranged and conducted as to be carried on quite independently of one another. The Burnside Mill is separated from the others by the river Cart, and employs about 250 hands. The main building is four storeys in height, and 150 ft. in length by 40 ft. breadth. It was erected in the year 1859, but since that time another building of smaller dimensions has supplemented its resources, and a small courtyard, spanned by a bridge, connects the two buildings together. The machinery of the Burnside Mill, including 26,000 spindles, is driven by a pair of coupled beam-engines of 450 horse-power indicated, but capable of working up to a much higher pressure. Musgrove and Sons, of Bolton, are the makers. The cylinder is 37 in. in diameter, and the length of stroke 5 ft. The fly-wheel is 8 ft. diameter, and about 20 tons weight. It goes at the rate of 55 revolutions per minute. These engines are fed by five two-flued Cornish boilers, two of them of recent introduction, being fitted with Galloway tubes. Their dimensions are 30 ft. length by 7 ft. diameter. The whole process of thread making appears to be very simple. The first operation is that of running the cotton twofold from the rope on to bobbins, after which it is manipulated on doubling-frames, and finally it is wound on reels previous to being bleached or dyed. The doubling-frames chiefly used at the Burnside Mill have been recently introduced, the invention being only three or four years old and are not unlike the old silk frame. They are provided with a checking motion for obviating waste, the bobbin coming to a dead halt immediately a thread is broken. The ordinary doubling-frame will produce about 300 lbs. of No. 40 thread per week. The speed is, of course, regulated by the texture and quality of the twist. There are two kinds of doubling-frames in operation, the essential difference between them being that on the one the bobbin is a fixture, while on the other it runs loose. The one is called a fly doubling-frame, the other is known as a traveller, and we understand that the first cost of the traveller is 25 per cent. more than its competitor, which is the oldest, although not the most economical of the two.

The Linside Mill is on the left bank of the Cart, directly opposite the Burnside Mill, from which it is approached by a very elegant iron bridge. It affords employment to upwards of 300 hands, and the machinery, which is almost identical with that of the neighbouring mill, is driven by a pair of beam-engines, working to about 420 inch-rated horse-power; diameter of cylinder 33 in., and length of stroke 5 ft. These engines are of lighter make than the others we have described, and have been working for close on 20 years. Craig, Fulton, and Co., of Paisley, are the makers. Steam is generated in four ordinary Cornish two-flued boilers, placed in pairs back to back, immediately outside the engine-house, which occupies the centre of the main building. In connection with the Linside Mill there are a number of auxiliary departments carried on, including the dyeing of the thread and the manufacture of the spools or bobbins on which the thread is wound ready for the market. The latter are turned on various self-acting machines, each capable of producing 40 complete bobbins per minute, or 100 gross per day. There is another description of machine, worked by hand, used for the deeper bobbins. In another part of the mill we come upon the glazing department, where there are 40 glazing-machines in operation, and ascending to the upper flats we come upon the spooling department, which is one of the most interesting in the trade. One set of spooling machines is worked singly by hand, and the other is altogether self-acting. The latter is a most ingenious contrivance. William Weild, of Manchester, is the patentee. Each machine contains eight spindles, and so constructed that there are eight spools undergoing the same processes simultaneously. One girl is sufficient for each machine, that is required of the attendant being to substitute empty spools for those that the machine fills and throws off ready for the market. Each machine of eight spindles is capable of throwing off 25 gross of 200 yards each daily. There are only six of these machines in operation at the Linside Mill, where they have only lately been introduced, but it is in contemplation to make a considerable addition to this number. Of hand spooling machines, however, there are no fewer than 200 in operation, each capable of throwing off four gross per day of 200 yards each. In the Linside Mill there are upwards of 18,000 spindles. The building is 200 ft. in length, by 40 ft. in breadth, and rises to the height of four storeys. Immediately in front of the mill is a large building, intended for storage purposes, has just been erected. The Seedhill Mill is only separated from the Linside Mill, of which for all practical purposes it really forms a part, by a courtyard. This is the original, or parent establishment, the other two mills having been added at subsequent periods to supplement its inadequate resources, and it is here that all the packing and finishing work is executed. The Seedhill Mill affords employment to upwards of 400 hands. The spooling and other machinery which it contains is driven by a pair of diagonal high pressure and condensing engines of 300 indicated horse-power, 34-in. cylinder, and 2-ft. stroke, working at the rate of 60 revolutions per minute. They were erected in 1865 by Musgrove and Sons, of Bolton. There are about 12,000 spindles in the Seedhill Mill, which is an irregular building, or rather series of buildings, four storeys in height, and forming almost three sides of a square. The boxes and cases in which the thread is packed are prepared here, and a large staff of women is employed in ticketing, and otherwise preparing the packages of thread for the foreign markets.

About a mile distant from this their principal establishment Messrs. J. and J. Clark have a smaller mill, which it is probable, when this huge business has been thoroughly centralised, they will abandon, although like their other mills it has been in operation constantly almost day and night for some years past. It is called the Cumberland Mill, and is very much smaller than either of the other three. The building is four storeys in height, and wears a somewhat old-fashioned appearance. There are 8000 spindles, to which motive-power is supplied by a single cylinder beam engine of 100-horse power. Only one process is carried on at the Cumberland Mill—that of simply making the thread, which has subsequently to be removed to the other mills for glazing or dyeing purposes. As already indicated, the packing and final preparation of the thread for the whole of the works is done at the Seedhill Mill. The firm do not own bleaching works, but there are so many establishments of this kind in the West of Scotland that they are never at a loss.

On the east of their Linside Mill Messrs. J. and J. Clark have just commenced the erection of another factory of colossal dimensions. It will measure 256 ft. long by 80 ft. in breadth, and 60 ft. in height to the top of the walls; it will thus be very much larger than either of the existing mills, and its whole appointments will be on the most improved and extensive scale. Constructed with every regard to proper light and ventilation, the ceilings being 14 feet, it is estimated that the new mill will contain 60,000 spindles, in addition to the necessary preparing machinery. Motive power will be supplied by a pair of beam-engines, of 1200 indicated horse-power, now being made by Musgrove and Son. The diameter of the cylinders, which are to be built on the condensing principle, will be 52 in., and the length of stroke will be 7 ft. The fly-wheel will be one of the largest in the country; it will weigh no less than 55 tons, and perform 28 revolutions per minute. The engine-house, built, of course, on a colossal scale, will be a model of its kind; and the fact that it is to be a storey higher than the rest of the building will give the mill a more imposing and effective appearance. The most notable feature of the machinery will be the entire absence of tooth-gearing, for which leather straps will be substituted, Messrs. J. and J. Clark following out in this respect a plan which has been adopted in several of the largest American factories with the most gratifying results. Six Cornish two-flued boilers, of 7 ft. diameter and 30 ft. length, will be erected in the meantime, but provision will be made for adding two more if at any future time they should be found necessary. The boilers will be fitted with Galloway tubes and Bowling rings. Altogether, we will be safe in asserting that when their new mill has been completed, Messrs. J. and J. Clark's mills will be the largest of this kind in the world, and the 1900 hands which they employ at present will, in all probability, be largely augmented.

MINING IN LINCOLNSHIRE.

In North Lincolnshire, the most recently-discovered of our ironstone fields, rapid progress is being made, not only in the development of the ore but in the production of pig-iron, and the neighbourhood of Frodingham, busy as it is, and has been, will soon present a scene of unwonted activity, whilst the place, not many years since a vast moorland waste, before long promises to have a prosperous town in its midst, with a large and thriving community. The first furnace was erected in 1864 by the Messrs. Dawes, who subsequently erected two more, and were followed by the Messrs. Cliffe, or the Frodingham Company, and by Mr. Adamson. The ore was actively worked from the commencement, so that in 1869 more than 253,000 tons were raised, the production of pig in the same year being 33,786 tons. The ore is of a rather peculiar character, is put into the furnace without being calcined, contains its own flux, yields about 30 per cent. of iron, or nearly so. The iron produced from it is said to strongly resemble the Prussian spiegeleisen, used in making Bessemer steel, and is good demand for makers of wire, tyres, and fine castings. An analysis of it gave the following results, we are informed:—

Iron	92·18 per cent.
Carbon	3·24 ,,
Manganese	2·10 ,,
Ash	·90 ,,
Tetanium	·90 ,,
Calcium	·52 ,,
Phosphorus	·16=100·00.

That the raising of the ore and the making of iron in the district has so far repaid those engaged may be inferred from the fact that the Messrs. Dawes, who are now amongst the largest private producers in the kingdom, in addition to having three blast-furnaces (two of them out for repairs), are now putting four more up. They are all to be iron-cased, and on the best principle. In addition to the ore used on the spot, the firm named send a good deal to their furnaces at Milton and Elsecar, near Barnsley, for mixture with the local ore in that district. The Frodingham Company, who have had two furnaces in blast for a considerable time, are erecting two more iron-cased ones, with all the necessary machinery and appliances, on a very extensive scale. Mr. Cliff, the proprietor, has also recently bought several hundred acres of land with the stone, in addion to the extensive tract he works under the lessor. The North Lincolnshire Company (Adamson and Co.) have also a large furnace, capable of producing 900 tons of ore monthly.

In addition to the above extensions, a new company (Scunthorpe Iron Company, Limited) has just been formed, and purpose commencing operations by putting up three furnaces, iron-cased, of the most modern construction, and capable of producing 600 tons of iron weekly. By an arrangement made with the owner the stone is to be supplied at the comparatively low price of 3s. 6d. per ton of 21 cwts., with an eligible site for the works. It is proposed to erect the furnaces close to the main line of the Trent, Ancholme, and Grimsby branch of the Manchester, Sheffield, and Lincolnshire Railway, with accessible sidings, involving little or no cost for branch lines. The cost of the three furnaces is estimated at 40,000*l.*, and, with the present price of pig, a dividend of something like 25 per cent. is estimated. There is no doubt that the prospects of the company are good, and looking at the success which has attended the private firms at Frodingham engaged in making iron during the last few years, as shown by the putting up just now of so many new furnaces, the profits will be highly remunerative. It is thought by many persons that coal will be found in the district, and should such be the case all the works will be of greatly increased value. As it is, however, most of the coal, it may be said, is sent from the Barnsley district by way of Doncaster, and from which the rate is reasonably fair.

Should all the new works in course of erection, and contemplated, be completed within a reasonable time, next year, in all probability, will see the production of pig-iron trebled, whilst it is expected that a still greater increase may be looked forward to from the success of those engaged in the trade, and the large field open to capitalists for profitable investment; and seeing that the locality is one eminently suitable for the manufacture of iron, being not more than 30 miles from the Barnsley coal field, with direct communication by railway north and south from Doncaster, and near to the shipping ports of Grimsby, Goole, and Hull. The lessor of the minerals is Mr. Rowland Winn, M.P., a gentleman who has given every facility and inducements (aided by the well-known engineer, Mr. Roseby, of Haverholme House), to bring capitalists into the district, and who has also done a great deal in promoting the social condition of the rapidly increasing population now settling down in connection with the works in the neighbourhood of Frodingham.

THE IRON AND STEEL INSTITUTE.

The members of the Iron and Steel Institute of Great Britain have just paid their anticipated visit to the old South Staffordshire district. The usual business of the autumn session of the Institute commenced on Tuesday morning in the lecture-hall of the Dudley Mechanics' Institute.

The Council were well represented by Mr. Henry Bessemer, president; Mr. John Hartley, Wolverhampton, trustee; vice-presidents, Sir John Alleyne, Bart., Butterley; Messrs. I. Lowthian Bell, Newcastle; William Menelaus, Dowlais; J. T. Smith, Barrow-in-Furness; Robert Heath, Stoke-on-Trent; R. Cassells, Glasgow; Walter Williams, Tipton. Members of Council:—Messrs. W. R. Innes Hopkins, Middlesborough; C. Bagnall, Whitby; R. Fothergill, M.P., Merthyr; W. S. Roden, M.P., Stoke; T. E. Horton, Shifnal; G. J. Barker, Chillington; George Addenbrooke, Darlaston; H. O. Firmstone, Stourbridge. The general secretary, Mr. John Jones, Middlesborough, and the foreign secretary, Mr. David Forbes, London, were also present.

Members present in addition to the Council:—Messrs. G. Adams, Wolverhampton; T. H. Anderson, Westbury, Wilts; Daniel Adamson, Hyde, Manchester; John Addenbrooke, Darlaston; W. S. Ayrton, Saltburn-by-the-Sea; W. L. Allen, Bessemer Works, Sheffield; A. Baldwin, Wildon, near Stourport; J. Briggs, Barrow-in-Furness; J. J. Bleckly, Warrington; W. H. Bleckley, Ashfield, Warrington; G. H. Banks, Pontymister, Newport; W. Barrett, Norton, Stockton; P. D. Bennett, West Bromwich; T. Barker, Sheffield; Thos. Bantock, Wolverhampton; J. T. Bell, Sunderland; J. Biddulph, Swansea; Henry Brogden, Sale, Manchester; T. J. Bewick, London; Sir Antonio Brady, Stratford, E.; Messrs. W. Crossley, Askham-in-Furness; S. J. Clay, Derby; T. Claridge, Bilston; E. Crowe, Middlesborough; C. Cochrane, Dudley; J. Colquhoun, Bridgend, Glamorganshire; E. A. Cowper, Westminster, S.W.; C. E. Cowper, Westminster; J. Cliff, Wortley, near Leeds; J. Cliff, jun., Brigg, Lincolnshire; A. Carrington, Chesterfield; J. Clark, Manchester; W. Davis, Aberdare; J. Dodds, M.P., Stockton; T. Douglas, London, E.; W. Evans, Bradford, Yorkshire; R. Eastwood, Derby; R. Farley, West Bromwich; W. Fletcher, Workington; Edwin Fox, Sheffield; C. D. Fox, Westminster, S.W.; Thomas Fell, Warrington; W. Ferrie, Glasgow; W. Farnworth, Dudley; W. Goddard, Longton, Stoke-on-Trent; C. J. Galloway, Manchester; J. E. Goldwyer, Bradford; M. Grazebrooke, Dudley; P. Greck, London, N.W.; John Gjers, Middlesborough; William Gill, Middlesborough; J. H. Goddard, Loughton, Stoke-on-Trent; William Heath, Stoke-on-Trent; Wm. Henderson, Glasgow; Rowland Hill, Middlesborough; Charles A. Head, Stockton; C. J. Homer, Tunstall; J. I. Hopkins, London, E.C.; J. P. Hunt, Dudley; A. H. Hunt, Birtley Works, Chester-le-Street; P. Haggie, Gateshead; E. E. Hewitt, Sheffield; J. Head, Middlesborough; R. Haines, Bristol; N. Hingley, Dudley; J. H. Hosgood, Aberdare; J. A. Jones, Middlesborough; W. Jenkins, Cousett, Durham; E. F. Jones, Middlesborough; E. Jeffries, Bradford; B. Jayne, Clydach, near Abergavenny; J. Jones, Merthyr Tydvil; J. J. Jenkins, the Grange, Swansea; J. Jeavons, Millwall, London, E.; W. Jones, Merthyr Tydvil; R. S. Johnson, Durham; J. F. Kirkconel, Carnforth, Lancashire; H. W. Lewis, Blaina Works, Monmouthshire; F. Levick, Blaina, Monmouthshire; W. Lloyd, Darlaston; L. T. Lewis, Neath, Glamorganshire; R. Laybourne, Tredegar; J. D. Leigh, Patricroft, near Manchester; F. H. Lloyd, Wednesbury; W. T. Lewis, Mardy, Aberdare; J. Morrison, Newcastle; J. J. Bodmer, Newport, Monmouthshire; William Cockburn, Upleatham, Marske-by-the-Sea; Samuel Fox, Stockbridge, near Sheffield; F. Monks, Warrington; Thomas Massicks, Millom, Cumberland; George Morley, Bridgend, Glamorganshire; E. Marten, Dowlais, Merthyr Tydfil; A. S. McClelland, Glasgow; Robert Morton, Stockton-on-Tees; James Mackean, Middlesborough; E. B. Marten, Stourbridge; Walter Neilson, Glasgow; James Neilson, Bellshill, N.B.; Wm. Neilson, Bellshill; R. S. Newall, Gateshead-on-Tyne; W. G. Norris, Coalbrookdale; John Neilson, Summerlee, Coatbridge; W. Putnam, Darlington; William Price, Woolwich; T. W. Plum, Shifnal; J. W. Pease, M.P., Hutton, Guisborough; Wm. Prosser, Stockton-on-Tees; J. B. Pease, Middlesborough; Joseph Richardson, Stockton-on-Tees; James Ratcliffe, Gorton, Manchester; Jno. Rogerson, Newcastle-on-Tyne; E. J. Reed, Manchester; B. Round; Hange Furnaces, Tipton; D. R. Ramsay, Middlesborough; Edwin Richards, Chepstow, Monmouthshire; W. Richardson, Oldham; L. Richards, Dowlais; Jas. Ramsden, Barrow-in-Furness; Job Richards, Parkgate, Rotherham; Joseph Rowley, Blaina, Monmouthshire; R. C. Ransom, Ipswich; R. S. Roper, Newport, Monmouthshire; John Stevenson, Middlesborough; John Stores Smith, Chesterfield; J. J. Sparrow, Bilston; Thomas Southan, Muxton-in-Newport, Salop; John Saunders, Cookley, Kidderminster; E. Fisher Smith, Dudley; N. Neal Solly, Willenhall; J. F. Spencer, Westminster; George J. Snelus, Dowlais; F. Smith Shenstone, Sutton Hall, Lewes, Sussex; George Tosh, Brigg, Lincolnshire; E. G. Tosh, Whitehaven; Wm. Thomson, Normanton; John Thompson, Clarence Works, Middl

borough; Joseph Tinn, Bower Ashton, Bristol; George Thomson, Ruabon, North Wales; H. V. Trump, Rhymney, Tredegar; John Tate, Harrington, Cumberland; James Whitham, Perseverance Works, Leeds; Henry Ward, Wolverhampton; Alexander Wilson, Cyclops Works, Sheffield; John F. Wilson, Middlesborough; E. T. Wright, Wolverhampton; George Ward, Wolverhampton; Edward Wadham, Dalton-in-Furness; Thomas Walmsley, Bolton; James Wilson, Darlington; John Woodward, Ancoats, Manchester; W. G. Woodcock, West Bromwich; George Wilson, Glaisdale; P. Würzburger, Dalton-in-Furness; José a de Ybarra, Bilbao.

The PRESIDENT, in opening the meeting, said that it was with great pleasure that he saw before him so good an assembly of members of the Iron and Steel Institute, more especially so because on this occasion they were visiting one of the most interesting districts that this country represented in the iron manufacture. Indeed, they were in a district in which they might say that the great iron trade of this country took its rise. Its very cradle, its birthplace was around them. He was sure that in visiting this place they would all see many things interesting to the individual manufacturer, whether it be taken from a manufacturing point of view or as a question of scientific interest. There were in the old works around that district many old furnaces that would, perhaps, strike the minds of many gentlemen who had come to South Staffordshire for the first time from the newer districts. Cleveland men would look on some of the small furnaces of Staffordshire with the eye of those who might reason that they had something newer, better than what they then saw. But he thought they must cast their eyes a little further to see where these old furnaces took their patterns from. In the old days, when charcoal was the only fuel, the ironmasters could say, "We have near Tunbridge two large furnaces in which we can absolutely cast a cannon of 15 cwts. once a day." (Laughter.) It was from these that the old Staffordshire ironmasters had to start, and when they knew that the iron that they had produced from charcoal and coal had given fame to their county, when they knew how Staffordshire plate and Staffordshire bars were valued all over the world, they should look upon the objects around them as of great interest, embracing work worthy the study of the iron manufacturers generally. (Applause.) He would not further occupy their attention.

NEW MEMBERS.

The election of new members was then proceeded with. At its close Mr. Head and Mr. Plum announced that the following gentlemen had been elected:—

Allen, W. D., Bessemer Steelworks, Sheffield, Steel Manufacturer and Merchant.
Ayrton, William Scrope, Saltburn-by-the-Sea, Iron Manufacturer.
Armitage, William James, Farnley Ironworks, near Leeds, Ironmaster.
Armstrong, I., Solway Hematite Iron Co., Maryport, Blast-Furnace Manager.
Bewicke, Thos. John, 2, Westminster Chambers, London, Mining Engineer.
Bourne, John, 64, Mark-lane, London, Civil and Mechanical Engineer.
Bayo, Federiro, La Felguera Works, Asturias, Spain, Manager of Ironworks.
Baker, Wm., 46, High-street, Sheffield, Consulting and Analytical Chemist.
Bladen, Charles, Blochairn Ironworks, Glasgow, Manager of Ironworks.
Brady, Sir Antonio, Maryland Point, Stratford, London Representative of the Bowling Iron Company.
Carrington, Arthur, Wingerworth Ironworks, Chesterfield, Ironmaster.
Cliff, Joseph, Jun., Frodingham Ironworks, Brigg, Lincolnshire, Ironmaster.
Crawshay, George, Gateshead, Iron Manufacturer.
Deas, James, Whitehaven, Ironmaster.
Dillwyn, Lewis Llewelyn, Hendrefollan, Swansea, Partner in Steelworks.
Douglas, Thomas, Millwall Ironworks, London, Manager of Ironworks.
Dudley, the Earl of, Witley Court, Worcester, Proprietor of the Round Oak Ironworks.
Goddard, John Hackett, Lane End Ironworks, Longton, Ironmaster.
Griffiths, John, Altoft Hall, Normanton, Manager of Ironworks.
Hingley, Noah, Netherton Ironworks, Dudley, Ironmaster.
Jeavons, Joshua, Millwall Ironworks, London, Proprietor of Ironworks.
Johnson, Richard, 27, Dale-street, Manchester, Ironmaster.
Johnson, Thewlis, 27, Dale-street, Manchester, Wiredrawer.
Johnson, Richard S., Sherburn Hall, Durham, Director of Ironworks.
Levick, George, Grange Town Works, Cardiff, Iron Manufacturer.
Lewis, W. T., Mardy, Aberdare, Mining Engineer.
Mackean, James, Middlesborough, Ironmaster.
Marten, Edward Bindon, Stourbridge, Civil Engineer.
Martin, S., Jun., Clarence Steelworks, Sheffield, Steel Convertor and Refiner.
Muller, Charles Emile, Middlesborough, Director of the Britannia Iron Co.
Musgrave, John, Globe Ironworks, Bolton, Engineer and Boiler Maker.
Musgrave, Joseph, Globe Ironworks, Bolton, Engineer and Boiler Maker.
Newmarsh, William, F.R.S., London, Director of Ironworks.
Peacock, Benjamin J., Cradley, near Brierley Hill, Roll Turner.
Pearse, John B., Harrisburg, U.S., General Manager of Bessemer Steelworks.
Penrose, William, Swansea, Assayer.
Prosser, William, Stockton-on-Tees, Iron Manufacturer.
Ransome, Robert Charles, Ipswich, Director of Ironworks.
Reay, Thomas M., Whitworth, Ferryhill, Iron Manufacturer.
Spencer, Adam, Rolling Mills, West Hartlepool, Manager of Ironworks.
Thorneycroft, Thomas, Tottenhall, Wolverhampton, Ironmaster.
Williams, Richard Price, 9, Great George-street, Westminster, Civil Engineer.
Williamson, Hugh, Goldendale Ironwork, Tunstall, Ironmaster.
Wilson, George, Glaisdale Ironworks, Yorkshire, Ironmaster.
Winby, William Edward, Wednesbury, Civil Engineer.
Wood, John, Maryport Hematite Iron Co., Maryport, Manager of Ironworks.
Würzburger, Philip, Dalton-in-Furness, Mining Engineer.

The reading of the papers was then gone on with.

ON THE GEOLOGICAL FEATURES OF THE SOUTH STAFFORDSHIRE COAL FIELD, WITH SPECIAL REFERENCE TO THE FUTURE DEVELOPMENT OF ITS MINERAL RESOURCES.

BY MR. HENRY JOHNSON, OF DUDLEY.

The author states it is well known that South Staffordshire is one of the oldest of the great mineral-producing districts of Great Britain. It was in the immediate neighbourhood of Dudley that Dud Dudley first demonstrated the practicability of smelting clay ironstone with coal, and though his discovery neither brought him ease or profit, posterity has acknowledged the debt which the iron trade owes to this early ironmaster, and the scene of his successful experiments has for more than a century past been famous for the production of iron. In its virgin state the South Staffordshire coal field was remarkably rich, both in coal, ironstone, and limestone—indeed, in point of concentration of wealth no part of Great Britain has presented more striking characteristics, for within a comparatively short distance from the surface a great number of valuable seams of coal and ironstone exist. The most valuable seam is the famous 10-yard coal, which represents a deposit of cabonaceous matter not found in a single stratum in any other coal field of Great Britain. Notwithstanding, however, the extent of the minerals originally existing in this locality, the requirements of the local iron manufacture, and of the many other manufactures that spring up in the neighbourhood, together with the demand for domestic consumption, have lead to a large continuous extraction of coal, and it is generally admitted that the older portion at least of the Black Country is nearly exhausted. Under these circumstances it has become a matter of vital importance to South Staffordshire to ascertain how long the known deposits of coal will last, and also what prospects there are of following the coal measures underneath the red rocks which surround the coal fields on all sides. It was stated that the object of this paper was to give a sketch of the geological features of the locality, with special reference to the future extension of its mineral resources.

The author commenced with a general description of the geology of South Staffordshire. The Silurian rocks were first noticed. These consist of the Llandovery, Woolhope, Wenlock, and Ludlow series. The coal measures rest upon Silurian strata, which come to the surface in several places, but principally in a line of rounded hills north of Dudley and east of Wallsall. In the latter district the lower measures of the Llandovery sandstone and the Woolhope limestone crop out near to the village of Barr, and also near Hay Head. The Wenlock bed consists of two seams of limestone of remarkable purity, largely extracted for smelting purposes; and a considerable thickness of shale. The famous Dudley and Wren's Nest caverns, near Dudley, are excavations in the limestone. These strata yield large numbers of organic remains, chiefly trilobites, crinoids, and bivalve shells. The Ludlow rocks are found at Sedgley Beacon, and consist of limestone and shale. The same beds come to the surface of the Lye, near Stourbridge. The Old Red Sandstone, mountain limestone, and millstone grit are absent in the Midland Counties, the explanation being that the central part of England was dry land during the deposition of their strata. The coal measures of South Staffordshire were fully described in detailed sections, showing the succession in the south and central portions of the field, and also in the Cannock Chase district. Of course the Thick, or 10-yard coal, came on for special notice, and deservedly so, for the British coal fields do not furnish another such example of concentrated seams of coal. The coal measures are in this district comparatively thin, but they contain an aggregate thickness of nearly 100 ft. of coal, besides numerous beds of ironstone and fire-clay. The beds have been a good deal disturbed by igneous action, probably about the close of the carboniferous period. The measures are consequently dislocated by faults, which traverse the district both north and south and east and west. The principal faults are the Great Russell's Hall fault, which is a downthrow west of from 50 to 150 yards, commencing near Himley Hall, leaving Dudley and Rowley a little to the north, and is traceable in the direction of Hales Owen, until it is lost in the newer formations. The Dudley Port trough fault is a downthrow west of 150 yards, and upthrow west of 150, leaving a trough in the form of the letter V, and about 150 yards in width across the bottom. On the west side of Dudley there is the Brierly Hill trough fault, running approximately east and west, having a downthrow north of 80 yards. The Bentley trough fault is a downthrow north of 120 yards, and upthrow north of 23 yards. Igneous rocks are found in various parts of the field, but by far the most important mass is what are termed the Rowley Hills, south of Dudley. At Barrow Hill, north-west or Dudley, Powke Hill north-east of Walsall, and in a few other places, the same rocks also exist. There are also intrusive veins of this rock in many places, which have altered the coal which is in contact with the igneous mass. These rocks may be of a much younger age than the coal measures, but it is generally believed that they belong to the latter part of the carboniferous period. Recent mining operations have thrown considerable light upon the relation of the large mass of Rowley basalt to the coal measures beneath. It has been clearly demonstrated that the basalt forms only a comparatively thin capping over the coal measures, which lie in regular order beneath the ore, for the most part unaltered by their close contiguity to the igneous rock, which appears to have been forced up through a small opening, and to have spread itself over what was at that period dry land, or the bottom of a shallow sea.

Recent investigations have shown that the coal measures existing in an undisturbed state beneath the basaltic rocks of the Rowley Hills and several coal mines are now in active operation in what was, a few years ago, considered an unproductive area. The coal measures which shoot off from the red rocks on the eastern and western sides, by well-defined boundary faults, have thrown down the strata, and have brought the newer formations on a level with the coal. Along the northern and the southern boundaries no such faults have yet been made out, and hence it is supposed that the red rocks rest upon the coal measures in each of these directions. The east and west boundary faults are not supposed to cut out the coal measures, but to simply lower them a greater distance from the surface. On this assumption, there is reason to believe that coal will eventually be found on three, if not on all, sides of the existing field, by penetrating the surrounding rocks. Of late years much attention has been given to the assumed extension of coal underneath the red rocks, and a good deal of valuable information has been collected by those who have conducted experimental investigations. One of the earliest successful attempts to discover coal underneath the Permian was made by the late Earl of Dartmoor, at the Heath Colliery, West Bromwich, in 1832. After many years of difficult sinking through water-bearing rocks the Thick coal was discovered, and was afterwards worked over a large area, up to what was considered a downthrow to the west. More recently the belief gained ground that Thick coal would be found still nearer to Birmingham, and a company was formed a year ago, called the Sandwell Park Colliery Company, for the purpose of testing the ground. A trial shaft is now being sunk, at a point about a mile and a half west of the former Heath Collieries. If coal should be discovered here, then the existing field will receive a great accession to its mineral wealth, for in that case it would not be unreasonable to predict the connection of the Warwickshire coal field with that of South Staffordshire. Besides this sinking in the Permian, there has recently been several lateral explorations from the coal measures into the red rocks on the downthrow side of the western boundary fault, but these investigations have not determined the amount of downthrow. The author suggests that the only true test for that side of the coal field would be to sink a shaft in some favourable spot between the Shropshire coal field and that of South Staffordshire.

A few years ago two very important trial sinkings were commenced in the south end of the coal field; the first upon the Wassall Grove estate, near Hagley, was carried out by several parties, but the results were that after passing through the upper coal measures to a depth of 165 yards an inferior quality, about 3½ ft. thick, was met with, associated with about 25 ft. of very inferior Thin coals and bats, which clearly represented the Thick coal, but were of no commercial value. The pit was sunk to a total depth of 262 yards until the Ludlow rocks were reached. The second trial sinking alluded to commenced at the Manor Farm, near Halesowen, by Mr. John S. Dawes. After passing through the upper coal measures a bed of coal 3½ ft. thick was reached at the depth of 308 yards. Very extensive mineral explorations have been carried out, with the hope of discovering the Thick coal with improving indications. In this sinking the Ludlow beds were reached at a depth of 420 yards. Recently, also, the West Cannock Colliery Company, in their new sinking for coal, discovered the shallow and deep coals of Cannock Chase at a depth to the deep coal of 300 yards. This sinking passed through the pebble beds of the New Red Sandstone at a point beyond the predicted run of the great western boundary of the coal field. At Aldridge, the Coppice Colliery was about to be abandoned a short time ago, but a few gentlemen thought it desirable to sink and explore the measures lower down. They accordingly did so, and at a depth of about 400 yards they have discovered both the shallow and deep coals of Cannock Chase, 14 ft. in thickness, brought sufficiently near to work them together. This discovery will go far to connect the Warwickshire district with not only that of Cannock Chase, but it will become strong evidence in support of the connection existing between the South Staffordshire and Warwickshire coal fields. The author pointed out that from these explorations, and the discovery of coal under the Rowley Hills, South Staffordshire may look for her supplies, but more especially to the prospects of coal being found under the unexplored regions lying between South Staffordshire and the Warwickshire and Shropshire coal fields. He referred to the ease with which the correlation of the South Staffordshire and Shropshire coals and ironstones could be made, and referred to the report of the Coal Commission just issued, "On the probability of finding coal under the Permian and New Red Sandstone," and pointed to the fact of their having expressed a strong opinion in favour of the probabilities of coal being ultimately found between the two coal fields. The report, the author said, was equally favourable as to there being coal found ultimately between the South Staffordshire coal field and that of Warwickshire. The author estimated these two unexplored regions at six times the area of the South Staffordshire coal field, and he hoped the country may have yet to rejoice in the successful discovery of coal in these immense tracts of country referred to, which would enable South Staffordshire to hold her prestige among the iron manufacturing centres of the kingdom for ages to come, and the effort now made by the Iron and Steel Institute to further the object would not have been without its good results.

The following is a general section of the South Staffordshire coal field, condensed from the Geological Ordnance Survey by J. B. Jukes:—

Beds above the Upper Sulphur coal	Feet 500 to 600
Upper Sulphur coal	1½
Intermediate measures, about	140
Little or Two-foot coal	2
Brooch coal, about	4
Brooch binds ironstone	7 to 20
Herring coal	1
Pins and Penny earth ironstone measures	6 to 30
Intermediate measures	38 to 157
Broad earth, cotch earth, and bat, containing the Ten-foot and Backstone ironstones	6 to 14
Thick coal	30
Pouncil bat, &c., containing 1 grain ironstone, and sometimes Whitrey ironstones	2 to 8
Gubbin ironstone, sometimes called black ironstone	2 to 8
Heathen coal	3
Intermediate measures	43
Rubble, or Lower Heathen coal	2 to 4
Intermediate measures	10 to 33
New mine or white ironstone, called also "bluestone" or cake	10 to 25
Sulphur coal	2 to 9
Intermediate measures	2 to 99
New mine coal	2 to 11
Measures containing fire-clay balls, ironstone occasionally	2 to 40
Fire-clay coal	1 to 14
Intermediate measures	2 to 10
Getting rock ironstone occasionally	4 to 5
Poor Robin's ironstone measures	3 to 5
Intermediate measures	18 to 50
Rough Hill white ironstone occasionally	2 to 19
Bottom coal	3 to 12
Gubbin and balls ironstone	10
Intermediate measures	18 to 50
Singing or mealy-grey coal	2 to 4
Blue flats ironstone	2 to 9
Intermediate measures	10 to 14
Silver threads ironstone	4 to 7
Intermediate measures	6 to 15
Diamond's ironstone	2 to 3
Lowest measures	50

Silurian shales and limestone follow.

When Mr. Johnson had finished his paper, the PRESIDENT, finding that no one was disposed to discuss it, remarked that a subject of so much importance to Staffordshire could hardly have been omitted at this meeting. A paper of such interest on that occasion could scarcely have been omitted on the Iron and Steel Institute visiting Staffordshire. The supply of coal in South Staffordshire had been gradually getting less and less; the efforts that might be made under the suggestions that they had just heard would go far to restore Staffordshire to her originally high position—not that he meant that county had lost that position. Still they all knew that the coal sellers were getting rather low, and it would be a great satisfaction to everyone to know that new stores were being opened out. He was sure that they would all agree with him that great thanks were due to Mr. Johnson for his intelligible and excellent paper. (Applause.)

A DESCRIPTION OF THE AYRESOME IRONWORKS, MIDDLESBOROUGH, WITH REMARKS UPON THE ALTERATION IN SIZE OF CLEVELAND FURNACES DURING THE LAST TEN YEARS.

BY MR. JOHN GJERS, MIDDLESBOROUGH.

This paper was divided into two parts, the first having reference to the gradual increase in the size of the Cleveland blast-furnaces, and the second part being a description of the Ayresome Ironworks, Middlesborough. The author stated that the credit of having proved that a considerable increase in the size of blast-furnaces is practicable, and may be of great advantage as a means of economising fuel, is due to the ironsmelters of Cleveland. The first blast-furnace was built in Cleveland, in 1851, by the late Mr. John Vaughan, who followed the practice of older districts, and made his furnace 42 feet high by 15 feet diameter at the bosh. Up to 1858 there was a gradual increase in size, the furnaces in that year being 56 feet in height by 16 feet bosh. The results of this increase in size were so satisfactory that Mr. Vaughan was led in that year to re-build one of the Witton furnaces, and to increase their size from the original 42 feet by 13 feet to 61 feet high by 16 feet 4 inches bosh. This may be said to be the first decided step towards the great increase in size which followed, the comparative results being so much in favour of the large furnace over the original small one that it soon became an undoubted fact that economy was to be found in that direction.

Although the scientific reasons which led to a saving of fuel through an increase in size were at that time not clearly understood, yet the practical results obtained were so beneficial that they culminated in that revolution unparalled in the blast-furnace history of any district, in which all the original furnaces and plant were razed to the ground, and new ones on the now established improved principle were built in their stead. The author stated that the way in which this increase in size of furnaces was carried out, together with numerous other improvements, reflected credit on the Cleveland ironmasters, and tested their enterprising spirit.

The following table gives the furnaces in the order of their respective dates:—

Date.	Name of Firm.	Number built.	Height.	Diameter of bosh.	Cubic capacity.
1851	Bolckow and Vaughan	3	42f. 0in	15f. 0in	4,5[illegible]
1853	Bell Brothers	6	47 6	16 6	6,17[illegible]
1853	Bolckow and Vaughan	6	54 0	15 0	7,1[illegible]
1853	Gilkes, Wilson, Pease, and Co.	2	45 6	14 6	5,1[illegible]
1854	Cochrane and Co.	4	55 0	16 0	7,17[illegible]
1854	B. Samuelson and Co.	3	50 0	14 0	5,0[illegible]
1854	Bolckow and Vaughan	3	54 0	15 0	7,1[illegible]
1854	Gilkes, Wilson, Pease, and Co.	2	55 0	14 6	6,8[illegible]
1856	Stockton Furnace Company	3	50 0	16 0	6,3[illegible]
1856	Norton Iron Company	3	50 0	15 0	6,0[illegible]
1858	Thomas Vaughan	6	58 0	16 0	7,0[illegible]
1858	Hopkins, Gilkes, and Co.	2	56 6	16 0	7,2[illegible]
1858	Jones, Dunning, and Co.	0	58 0	17 0	8,0[illegible]
1858	Bolckow and Vaughan	1	61 0	16 4	7,9[illegible]
1861	Gilkes, Wilson, Pease, and Co.	1	55 0	16 0	7,7[illegible]
1861	William Whitwell and Co.	3	60 0	20 0	12,7[illegible]
1862	Bolckow and Vaughan	2	75 0	16 6	11,9[illegible]
1864	B. Samuelson and Co.	4	69 0	20 0	15,5[illegible]
1864	Thomas Vaughan	3	70 0	18 0	12,0[illegible]
1864	Lloyd and Co.	4	67 0	20 0	15,0[illegible]
1864	Thomas Vaughan	6	81 0	19 0	16,0[illegible]
1864	Stevenson, Jaques, and Co.	3	70 0	22 0	17,0[illegible]
1865	Gilkes, Wilson, Pease, and Co.	2	75 0	21 0	17,7[illegible]
1865	Bell Brothers	2	80 0	20 6	15,3[illegible]
1865	Bolckow and Vaughan	2	95 6	16 0	15,0[illegible]
1866	Bolckow and Vaughan	1	75 0	20 0	12,9[illegible]
1866	Hopkins, Gilkes, and Co.	2	75 0	24 0	20,0[illegible]
1866	Swan, Coates, and Co.	2	75 0	20 0	16,0[illegible]
1866	Bell Brothers	2	80 0	17 0	11,3[illegible]
1867	Norton Iron Company	2	95 0	25 0	26,0[illegible]
1867	Cochrane and Co.	2	76 0	28 0	20,0[illegible]
1868	Gilkes, Wilson, Pease, and Co.	1	75 0	24 0	23,3[illegible]
1868	Stevenson, Jaques, and Co.	1	70 0	23 0	18,0[illegible]
1868	B. Samuelson and Co.	1	69 0	21 6	16,0[illegible]
1868	Lloyd and Co.	2	80 0	21 6	18,0[illegible]
1868	Jones, Dunning, and Co.	3	73 0	18 0	12,0[illegible]
1868	Bolckow, Vaughan, and Co.	2	95 6	22 0	25,9[illegible]
1868	Bolckow, Vaughan, and Co.	1	95 6	23 0	28,0[illegible]
1869	Thomas Vaughan	3	85 0	25 0	26,0[illegible]
1870	Bell Brothers	4	80 0	25 0	25,0[illegible]
1870	Stockton Furnace Company	2	80 0	24 3	24,3[illegible]
1870	Swan, Coates, and Co.	1	75 0	23 8	22,2[illegible]
1870	Cochrane and Co.	2	90 0	30 0	41,0[illegible]
1870	Gilkes, Wilson, Pease, and Co.	2	85 0	27 0	32,0[illegible]
1870	B. Samuelson and Co.	2	85 0	28 0	30,0[illegible]
1871	Bolckow, Vaughan, and Co.	2	95 6	24 0	28,2[illegible]
1871	Lackenby Iron Co. (building)	2	85 6	25 6	26,0[illegible]
1871	Gjers, Mills, and Co. (building).	2	85 0	25 0	26,0[illegible]

It is worthy of notice that, with only one or two exceptions, there are now no furnaces remaining of all those built prior to 1859, that, practically, the present plants working in Cleveland date since then. The author stated it was his opinion that the useful maximum of both height and diameter of bosh had already been attained if not exceeded, and that there were already signs of a retrograde movement. The object of increasing the size of the Cleveland furnaces are twofold; first, to increase the make; and, secondly, to economise fuel; a third has followed gratuitously—improvement in quality. The author believes that not much has been got from the first consideration; the saving in fuel, however, has been considerable, and may be put down at from 7 to 8 cwts. of coke per ton of iron made. The quality of the iron is also much improved, being more highly carbonised, and more uniformly soft throughout, than it originally was. A great diversity of internal shapes exists in the Cleveland furnaces, but it is owing to each firm having been left to carry out their own ideas, and being unable to profit by the experience of their neighbours. In concluding this part of his paper the author observed that more settled ideas now prevailed with respect to the sizes of blast-furnaces, and it is seen that mere cubic capacity is a mistake, as it is only in those furnaces where proper regard has been paid to the proportions and distribution of the materials charged that the benefits from the increased size have been fully realised.

The author commenced the descriptive part of his paper by stating that the Ayresome Ironworks are built upon 32 acres of land, with a frontage to the River Tees of 330 yards. There are four furnaces, two of which have been in blast since the end of March this year, the second pair are expected to be ready for blowing in during the spring of next year. The whole of the minerals as they arrive are placed in the Standage sidings, and are taken from that place by a four-wheeled tank engine as required over a 25-ton weighbridge, from thence they descend by the force of gravity to the lift; they are raised by a pneumatic hoist to the top of the depôts, and afterwards tipped into the kilns and boxes respectively. The ironstone is calcined by a proportion of about one in twenty-five of small coal

this, as well as the coke, is filled into iron barrows, and after being weighed is sent up to the top, four barrows at a time, by the pneumatic lift. Each barrow carries 5 cwts. of coke, and from 12 to 12 cwts. of ironstone, the furnace charge being eight barrows of coke, eight of ironstone, and four of limestone. The furnaces are closed with the cup and cone arrangement, the gas being carried by downcomer tubes into a culvert below ground, from whence it is distributed to the stoves and boilers. There are 10 boilers of the plain cylindrical egg-ended shape, 60 ft. long and 4 ft. 6 in. in diameter. The three engines are of the direct-acting, vertical, self-contained class, two of which are capable of blowing the four furnaces.

Connected with the works is a wharf now building, which will have a frontage of 210 feet, and on it will be two 4-ton travelling steam cranes. There are also the necessary repairing shops, consisting of smiths', joiners', and fitting shops, with engine-shed, storeroom, offices, &c. The furnaces are entirely built of fire-brick, the pillars and outer casing being built of common size inferior fire-brick, and the lining of best fire-brick, in lumps 24 inches long by 6 inches thick. The height of the furnaces is 85 feet. At the widest part they are 25 feet, and the hearth is 8 feet by 3 feet deep. Each furnace is blown with three tuyeres fixed in water-plates in each breast, and the lower part of the hearth is surrounded with water-boxes, bolted together. The author then proceeds to describe in detail the arrangement of the cast-iron pipe stove introduced by him at this and other works; the calcining kiln, also devised by himself, and extensively used in many ironworks; likewise his furnace hoist on the pneumatic principle; concluding with a description of the boilers and a very fine set of blowing-engines, which were built by Messrs. Cochrane, Grove, and Co., of Middlesborough.

When the Secretary had finished reading Mr. Gjers' paper, the PRESIDENT said he was sure that those who had listened to the eminently practical character of the paper would feel great interest in the laborious experiments that Mr. Gjers had made. When the paper had been printed, and the mass of information it contained assumed a tabular form, it would form a most valuable communication as to the heights, sizes, and products of blast-furnaces. These particulars, it might be hoped, would be supplemented by some discussion of the peculiar working of these various sized furnaces; so that when they knew the size and dimensions, and they might also know how they behaved themselves, the different kinds of blast, and the various descriptions of iron, they would, he was sure, appreciate the thoroughly practical character of the illustrations and discussions brought forward, and conducted by men so able as Mr. Bell. (Applause.) He begged the thanks of the meeting to the gentleman for his very able paper. (Renewed applause.)

FURTHER RESULTS OF THE USE OF HOT-BLAST FIRE-BRICK STOVES.

BY MR. THOMAS WHITWELL, THORNABY IRONWORKS, STOCKTON.

Mr. Whitwell began by saying that the paper which on a former occasion the writer had the honour of submitting to the members of the Iron and Steel Institute gave a description of a set of hot-blast fire-brick stoves that had been put up by him at the Consett Ironworks. The results therein set forth having occasioned much remark, and having also been twice referred to and commented upon in the pages of the Proceedings of the Institute by a most able authority, the writer desires on the present occasion to present to the Institution the results of further continued working, extending in one case over 2½ years, in the other over the space of 1½ year.

Through the courtesy of Mr. Jenkins, the general manager, and with the express sanction of the Consett Iron Company (Limited), the valuable tables extracted from the books of the company are now brought before the Iron and Steel Institute, in the hope that the truth may be arrived at relative to the application of hot air to the blast-furnace. In the first place, we may refer to the sections of furnaces to which the stoves are applied, as in judging of comparative results our conclusions are apt to be erroneous if we, at the same time, do not take into consideration all the circumstances relating to the subject. In the previous paper it was stated that the stoves were applied to a furnace 55 ft. in height, 20 ft. bosh, 8 ft. hearth, that the average heat attained, as proved by repeated trials by competent individuals, specially Mr. Charles Cochrane and Mr. E. A. Cowper, was upwards of 1400° at the tuyere; that the mineral charged into the furnace consisted of one-third hematite and two-thirds Cleveland, a mixture with a percentage of metallic iron of 489°; that the consumption of coke over the past twelve months per ton of iron was 17 cwts. 3 qrs., the weekly make being 380 tons, and the quality grey 4, the proportion of white iron being only 2 per cent. over the year. It was also stated that a more powerful plant of stoves was being applied to a second furnace. Since that paper was read a series of most able papers have been contributed to the Institute by Mr. I. L. Bell, one of which was devoted to the consideration of the results of the working of the furnaces at Consett, in the course of which that writer stated that the increased heat in the blast supplied to the later furnace had been followed by increased consumption of coke, and the analyses of the gases at the top of the furnaces showing more Co and less Co_2, the writer deduced therefrom that the results must have been produced by the heat of the blast only; he also states, pp. 322 of the Proceedings, that he suggested to the company that the heats should be reduced, and he understood that the results had been advantageous. Let us here for a moment refer to the relative sections of the blast-furnaces working with the fire-brick stoves.

Fig. 1 shows the section of the blast-furnace No. IV. This furnace has a bosh, as stated before, 20 ft. diameter, the size being rapidly reduced upwards to a diameter of 15 ft., at a distance of 9 ft. below the charging plates; the furnace is charged with a cup and cone 10 ft. 6 in. diameter, the hearth is 8 ft. diameter, the angle of bosh 68°; there are five tuyeres, each 4½ ft. diameter at the nozzle. The pressure of blast was at first 2¾ lbs., and latterly 4 lbs. per square inch at the engine-house. This furnace was blown in Feb., 1869, and the averages commence six weeks after—April 10. At first the pressure of blast was 2¾ lbs., and during the past year was increased to 3 lbs. Over that period the temperature of blast was about 1400°, and the average consumption of coke was 17 cwts. 3 qrs. per ton of iron, the make being 373 tons per week. During the latter half of the year the make rose to 401 tons per week, and the coke fell to 17 tons 20 cwts., the quality was 84 per cent., No. 4 grey forge, the white being 2 per cent. For 26 consecutive weeks no white iron was made, a regularity in working which has rarely been exceeded. During the next three months there was occasionally a little hanging, and some forge slag was put in to remedy this, and the average working for the third period shows make over 1¼ yard, 383 tons a week; coke, 18 tons 0 qr. 3 lbs.

The blowing power was at this time improved, and a higher pressure of blast was tried. The furnace was put on its old burden of one-third hematite and two-thirds Cleveland, and with the increase of blast you will notice a proportionate increase of production, the perfect charging of the furnace being proved by the constant regularity of the make. You will, however, notice that when the pressure was increased the production of iron showed a corresponding increase, but the stoves being already worked to their full power were not able, with the increased quantity of blast, to develope the same temperature. Hence we find that when the pressure of blast was raised to 4 lbs. in the beginning of 1871 the production of pig, as compared with the past year of 2¾ lbs. blast, increased in like ratio, or about 30 per cent.; but with the reduction of the temperature of the blast to 1200° the consumption of coke had risen from 17·3 to 19·2 nearly, thus proving beyond all doubt that reduction in temperature at Consett has, so far as coke is concerned, been followed by increased consumption, represented in market value by the sum of nearly 1s. 3d. per ton of iron, based on the value of coke in the Middlesborough district. The production of iron at this furnace is now upwards of 510 tons per week. The largest production has been 567 tons in one week.

Let us now turn to No. 5 furnace, and see how far we may trace any resemblance to No. 2 in its working results. In 1869, desiring to increase the production of pig-iron to 450 tons a week, and at the same time to increase the economy by additional cubical contents, as set forth by writers on the blast-furnace, the Consett Company built No. 5 furnace. This was the same height as No. 4—85 ft.; and whilst preserving the same angle of bosh they increased the diameter of this furance to 22 ft. 6 in., the diameter 9 ft. below the charging plates being 20 ft. 6 in., as compared with No. 4, the diameter of cone 12 ft. 6 in., against 10 ft. 6 in. in the former case; the diameter of hearth 8 ft.

Four fire-brick stoves, with an increase of 17 per cent. in heating surface, were applied to this furnace, and on first blowing in the heats were about 50° higher than in the case of No. 4, and in 1869 more regular. The produce of pig-iron was, however, somewhat irregular, about 25 per cent. of white pig being made in the first week, and this has continued to the present time; whilst the coke with the best heats has been on an average 1½ cwt. more than in the case of No. 4, when that furnace was working at heats of 1400°. We may here observe that from the first week this furnace has made all qualities of pig, from No. 1 to white, the burden being one-third hematite and two-thirds Cleveland; but each month the production of white, without any visible cause, has continued. The heat and pressure of blast being perfectly regular, it might have been expected that the production of pig should have partaken of the same regularity; but such not being the case, the cause must be looked for elsewhere.

The various diameters of the furnace No. 5 are common to furnaces in the Cleveland district, only the height is different. Several opinions were taken, but though the writer traced the irregularity of yield to the charging other ironmasters considered that there was no fault to find either with this or the shape of the furnace. The make averaged 393 tons per week for the first three months, but the coke was 19 cwts. 3 qrs. The furnace then had increased muzzles put on, but the production remained nearly stationary. It is not necessary to detail all the working of the furnace, as that may be seen from the table extracted from the works' books. Early in 1871, as already related, Mr. I. L. Bell advised a reduction of the heat. The temperature was reduced to 1250°, so as to compare with No. 4 on equal temperatures. The pressure of blast was the same in both cases; but, alas! the coke, so far from coming down, went up till it reached 21 cwts. 2 qrs., being an increase of 2 cwts. coke for a decrease of temperature of 200°. The irregularity continued, and the production of 25 per cent., while pig maintained its ground. The muzzles were now increased to 2 by 5 inches and 3 by 4½ inches, or 84 square inches of area, but without making more pig; in fact, the production is at least 60 tons per week less than No. 4, which has 75 square inches of tuyere area, and at an increase in coke of 2 cwts. per ton of iron, notwithstanding the quantity of white made.

The Consett Company are now only waiting a favourable opportunity to stop the furnace, and reduce the upper part to the same diameter as No. 4, and put in an equal-sized bell, which, it is hoped, will remedy the defect, as it is evident that the present dimensions, whilst they may answer in a furnace 80 ft. high, will not work on a 56-ft. furnace with the mixture used at Consett, and hence it may be deduced that in the practice of No. 4 the charges descend through the furnace in such manner that the coke is intimately mingled with the mine and ore, which are thus reduced chemically, and on arriving at the zone of fusion the smelting takes place with regularity. In the case of No. 5, it appears that the coke and larger pieces of the charge roll to the centre, the small mine and ore remaining nearer the periphery of the furnace. The blast forces its way up the line of least resistance—the centre—and reduces the coke to Co, the minerals unreduced for want of sufficient contact with the carbon arrive at the tuyeres in almost a raw state, and the result is the production of white iron very irregularly.

It is not the intention of the writer to enter into the question of the composition of the gases, as given by Mr. I. L. Bell, as having stated the case as presented by the works' books, he prefers to leave it to the consideration of the practical ironmaster. At the same time it may here be stated that the Consett Company decided to apply the stoves to two more new furnaces, the size adopted being a mean between Nos. 2 and 5—21 ft. bosh, angle 72°, size under the bell 18 ft. 6 in., diameter of bell 11°—with a view of arriving at the maximum economy by experiment, there being no unanimity among the advisers of the company as to the best form of furnace. One of these new furnaces (No. 2) has only been in blast about two months, but so far, with equal heat of blast, the consumption of coke promises to be half-way between that of Nos. 4 and 5 furnaces.

The working of the stoves may be observed from diagrams, differing from the Siemens' system, where all the air is admitted at one place, and where, in consequence, a heat has even been attained for a short period of 1800°, but also where other heats showed 1150°, the mean being 1420°, the writer has endeavoured, by means of the admission of heated air amongst the gas at various points along the great passage composing the stove, to obtain a reservoir of caloric of as near an even temperature as possible. The power is reserved of increasing the temperature at the hot end should such be desirable, but his practice in smelting iron leads the writer to consider that the less deviation from a constant line of heat the better; the consequence is, therefore, that a regularity of heat (shown in diagram No. 2) is obtained, that, from the evidence of independent observers, is not to be met with in any other system of hot-blast stoves. There is no doubt that the great regularity of the working of No. 4 at Consett is in a large degree owing to the action of the brickwork in the stoves. The solid brick walls, though containing more material than is absolutely necessary for the mere purpose of heating the blast, form in actual practice large reservoirs of caloric at a temperature of 1400°, which only give off their internal heat when a stand takes place of (say) three-quarters of an hour at tapping time, a tuyere, or a scaffold (which for above a year the furnaces have been entirely free from), when, of course, in all cast-iron plant, no gas being produced, the stones are being cooled down, which cooling produces an effect on the furnace. At such a time as this, be it half-an-hour or three days, the fire-brick stoves being always bright-red throw their hot blast into the furnace when it actually needs it most, and the result, blast and charging being right, is the beautiful regularity observable in the production of pig in No. 4. The same powers are at work with No. 5, but they are neutralised by the action produced by the shape of the furnace in the charging.

Bearing in mind the slowness with which brickwork parts with its heat, the writer has, in the case of all stoves made in 1870 and 1871, taken out two walls in each stove, thus reducing the heating surface 600 ft. in each case; the result, however, is that the blast is longer in the stove, the combustion of the gas more vivid, and the heat developed in the blast greater in proportion to the gas used. It may here be observed that the ironmasters of Luxembourg are entering into active competition in economy with those of this country, two new furnaces being on the point of being blown in, with eight of the writer's fire-brick stoves. These furnaces are 66 ft. high, 22 ft. bosh, angle 70°, hearth 6 ft. 6 in., open-topped. The gases will be taken off by the Wasseralfingen system; a cone 10 ft. in diameter, of ½-in. plate, being lowered into the furnace to a depth of 2 ft., and the smelting materials first reduced to the size of road metalling, laid on to the furnaces carefully levelled by hand, by which means the engineer, Mons. Boulanger, of Charleroi, anticipates reducing his coke with mine yielding 34 per cent. raw, to a lower point than that hitherto arrived at with blast of 1000° temperature.

The conclusions that may be gathered from the results herein set forth point to the facts—1. That the increase of production in the the furnace No. 4 at Consett is directly in proportion to the increase in the amount of blast thrown into the furnace.—2. That other things, such as the action of the materials in charging and the form of furnace, being equal, a high degree of heat in the blast is in no degree incompatible with regulation of quality in the iron.—3. That in the two furnaces at Consett under consideration, although there was a great difference in the internal form and capacity, yet no reduction of temperature in the blast has been attended with economy, but that in both cases a reduction of 200° in the temperature of the blast has been attended by an increase of upward of 2 cwts. in the consumption of coke per ton of iron.

The writer's fire-brick stoves are being extensively adapted to furnaces to smelt pure hematite, for making Bessemer pig, cinder, Cleveland, stone, pare, &c.; and inasmuch as no ironmaster has yet practically found that increased heat of blast reduces his economy in smelting the use of these stoves is largely increasing, 16 being now in blast, and 60 in construction, in England, France, Luxembourg, &c. The writer, therefore, is satisfied to leave the further results from the use of his hot-blast fire-brick stoves to the careful consideration of the members of the Iron and Steel Institute, merely observing that in all cases the working ought to be compared with the section of the furnace, that no casual returns on any one day or week should be taken to represent the average working of a furnace, but that the balances of the works' books, as in the case of the Consett Iron Company (Limited), taken at stated intervals, present a concise view of the subject that speaks for itself.

The thanks of the Institute were accorded to Mr. Whitwell for his paper.

ON INCREASING THE HEIGHT OF BLAST-FURNACES IN THE MIDLAND DISTRICTS.

BY T. W. PLUM, OF MALINSLEE.

The subject of the following paper having grown in a certain degree out of the discussion upon the Ferrie furnace at the meeting in London, in March last, it may not, perhaps, be out of place to devote a few lines to the further consideration of the advantages likely to arise from Mr. Ferrie's plan of erecting high furnaces. In the course of the discussion referred to it was contended that "a very large proportion of the saving of fuel was due to the increased height of the furnace," and that little or no additional advantage was gained by the cross walls. It was, however, at the same time suggested by the writer, and accepted by the meeting, that the cross walls were calculated to answer an important purpose in relieving the weight that in an open furnace is imposed upon the materials, and thus enable high furnaces to be used in districts where the fuel is too tender to bear a considerably increased weight.

At the time the paper was read the particular construction of the Ferrie furnace was new to most of the members, and, consequently, the discussion upon it was to that extent from first-sight impressions, hence it may in this, as in some other instances, be of value to reproduce at a succeeding meeting notable features of any improvements bearing upon important operations in iron smelting, in order that complete justice may be done to an invention, and that the members may have the advantage of as full an illustration as possible, upon which to form a correct judgment of its value.

It will, no doubt, have occurred to many who have perused Mr. Ferrie's paper that the discussion did not exhaust the subject, and that it is worthy of a little further investigation. In coming to the conclusion that the saving of fuel in the furnaces that have been tried in Scotland was chiefly due to increased height we are, no doubt, correct; but that a portion of saving is due to the peculiar form of the furnace, as claimed by the inventor, must at the same time be distinctly acknowledged. Theoretically this may be accounted for by the check to combustion offered by the interposition of the cross wall at the height of 50 feet, so that while the coking is going on, and the minerals are absorbing heat in their progress downwards, the consumption of fuel is, no doubt, less in the Ferrie furnace than it would be in a furnace of precisely the same capacity of ordinary construction—that is, without the cross walls or chambers; and this view is practically confirmed by the comparative temperature of the escaping gases given in Mr. Ferrie's paper, the average of a number of tests having been from the Ferrie furnace 589° Fahr., and from a furnace at the Clarence Works 689°, notwithstanding that the ores in the former entered the furnace at 50° against 212°—the asserted temperature at which ores are charged into the Clarence furnaces; it must, therefore, be concluded that the novel and peculiar construction of the Ferrie furnace has more to recommend it than at first sight appears, and the advantage it promises to realise are worthy of more investigation by many members of the Institute. Without having seen one of the furnaces at work, or communicated with Mr. Ferrie, the writer has deemed it due to that gentleman to bring his furnace again under notice; the doing so may incidentally have the effect of removing an erroneous impression that unfortunately got abroad, that the invention was not adequately appreciated at the last meeting of the Institute, while drawing to it the attention of gentlemen who may possibly find it advantageous to examine more closely than they have yet done into its merits.

The example set by the Cleveland ironmasters of increasing the height of blast-furnaces has not yet been extensively followed, and it is still a question in the minds of gentlemen of great experience whether so much of the saving of fuel as attributed is really due to the increased height. We have in South Staffordshire furnaces working with a yield as low as 28 cwts. of coal to the ton of pig-iron, but whether that weight is actual standard measurement or is derived from the "I don't know how many cwts. to the ton system," prevailing in some places, it is impossible to say; but is is, nevertheless, believed extensively that, having regard to the difference in the quality of the materials, there is now as good work being done by some of the 50-ft. furnaces in Cleveland, so far as coal yield is concerned. The consequence of its premature production for the present meeting, the subject of this paper is not what the author hoped to have made it—a record of finished results, it consists, therefore, of mere notes of progress in an endeavour to engraft upon a very old and dilapidated "plant" some of the improvements that seem to have added so much to the prosperity of the northern ironworks. In bringing these notes before the members at the present time, the author endeavours to give effect to the impression on his mind that so much or even more value may sometimes be drawn from reports of trials in progress, and even of failures (if there be courage to record them) than from examples of complete success.

The difference in the form and condition of our older ironworks, and the diversity in the nature of materials in different districts, make it necessary to proceed with much caution in reconstructing or in adapting old furnaces to new modes of working; but if those who have the opportunity of pioneering in any degree will be good enough to make known their progress, and compare notes one with another, much mutual advantage may be gained, and we shall the sooner arrive at the certainty of what *can* and what *cannot* be effected in the way of change; acknowledging, as we all must do, that the older districts cannot remain stationary, surrounded as they are by so much energetic progress.

The Old Park furnaces (four in number) were nearly 50 years old, 45 ft. high, and about 14 ft. 6 in. at the bosh, the hearths and the necks of various dimensions latterly; a portion of the gas was taken from two of them by "Darby" bells, and utilised for raising steam only. In 1869 it was decided to erect one new furnace in place of one of the old ones; drawings were prepared of a furnace of the same height—namely, 45 ft.—but of more modern construction, with iron plate casing, upon twelve iron standards, close hearth, 6 feet 6 inches in diameter, six tuyeres equally divided, and provision for a portion of the gas to be taken off by a culvert round the neck of the furnace (about 200 inches area), the neck 9 feet in diameter, to a depth of 6 feet 6 inches, the top open, and at the bosh 14 ft. 9 in. diameter; the vertical "in-wall" commencing at 20 feet from the bottom of the hearth.

While in progress it was determined to make trial of an increased height of 15 ft., making the furnace 60 ft. high, and it was so finished and got to work, but at present the results obtained from it have not been complete, in consequence of both the heat and the pillar of blast not having been so much or so uniform as required for testing its capabilities, but as much the same conditions have prevailed with the other furnaces, the comparative work will illustrate the effect of the increased height upon the yield of coal. Compared with the best of the other two furnaces at work (one with a "Darby" bell), the best yield by the new 60-ft. furnace has been 10 cwts. of coal per ton of iron less than the best yield on record of the 45-ft. furnace; the ordinary working, however, ranges more in favour of the new furnace, being 12 to 15 cwts. less than the old furnace. The quality of the iron has been decidedly better; it has been uniformly greyer than indicated by the cinder, usually the reverse at the old furnaces. The heat of the blast and the pressure have within a few days only been increased, the heat to about 800°, and it will be further increased to 1000° or 1100° shortly, when the capability of the furnace will be more fully tested. The favourable comparison given by the higher furnace led to the raising of one of the old ones to the same height while working, by carrying up a casing outside the tunnel head above the 60 ft. height, leaving the gas culvert, which had been previously formed at the original height, the openings into it being about 6 ft. below the original charging plates, but the results are not

yet sufficiently ascertained to justify any communication upon this experiment.

From the experience thus far gained the writer arrives at the following conclusions:—

1.—That a considerably improved yield has been decidedly obtained from the increased height of the furnace described.

2.—That to the extent of 60 ft. it may be safe to construct furnaces in districts having tender cokes to smelt with (other conditions being adequate), but not to a greater height nor a larger diameter unless upon the "Ferrie" system, if, as assumed, it is found to answer the purpose of adequately relieving the materials from undue pressure, as well as of improving the yields, for which the actual experience in Scotland will doubtless be resorted to for guidance.

Upon the motion of the PRESIDENT, Mr. Plum received the thanks of the Institute.

ON MR. FERRIE'S SELF-COKING BLAST-FURNACE.

BY MR. I. LOWTHIAN BELL.

The author stated that, at the annual meeting of the Iron and Steel Institute, held in March, Mr. Ferrie described the construction of his furnace, and at the same time furnished an account of the ordinary work of this furnace, compared with the results obtained in one of the furnaces of the Coltness Iron Company, working in the ordinary way. The advantage to be derived from the increased height of furnaces having been demonstrated in the North of England, it was natural to enquire how much of the economy obtained by Mr. Ferrie was due to the increase of height, and how much to the heat evolved by the combustion of a portion of the furnace gases in the flues. Mr. Bell stated at the previous meeting that whether the fuel used in the furnace were employed in the shape of coke or coal, it was not until it had assumed the former condition that its real work in smelting began, and he pointed out that, viewing the process in this manner, it appeared to him somewhat doubtful whether the advantage of Mr. Ferrie's system was not chiefly due to the addition made to the height of the furnace, rather than to the self-coking portion of the charge. He was led to entertain this opinion from the fact that, taking the quantity of coke in the coal actually used by Mr. Ferrie, it corresponded, after making the necessary allowance for his richer stone, with the fuel used by the author's firm, where the coal is used in its coked state.

Within the last month the writer has been engaged in a series of estimates, in order to ascertain the precise nature of the heat evolution and appropriation in furnaces where the coal is used in its raw state, and these experiments have induced him to think that he was mistaken in the opinions expressed during the discussion upon Mr. Ferrie's paper. The author proceeded to demonstrate, with much minuteness, the precise amount of saving that is effected in the Ferrie furnace, and he came to the conclusion that half the saving of coal is due to the increase of height, and half to the combustion of the gases in the flues in the upper portion of the furnace. In this examination he confined himself entirely to an estimate of the actual evolution and appropriation of heat, but, as he was informed that all previous attempts to economise fuel in Scotland by means of higher furnaces than those in general use at the present day failed, it is possible that the intervention of the structure forming the upper part of the coking furnace may be useful in the manner alluded to by Mr. Plum, by relieving a tender material of a portion of the superincumbent weight. The author also alluded to the statement of Mr. Ferrie to the effect that in his furnace there was an improved yield from the ironstone. Although the qantity stated by Mr. Ferrie seemed large, the results obtained by comparing Coltness with Monkland appeared conclusive, and, therefore, he agreed with Mr. Ferrie in thinking that the saving at the top of the furnace is the only way to account for the difference in the yield mentioned by Mr. Ferrie, and confirmed by the Coltness Company.

Mr. Bell's paper having been read,

The PRESIDENT said he was sure they would have followed the last speaker with great interest. They remembered the excellent paper that on a former occasion Mr. Ferrie read on this subject. Nothing could be more satisfactory to the members of the Institute than to see subjects like these taken up by such able men as the class to whom Mr. Bell belonged. Such an occurrence was one of the many instances of the great advantage to the iron trade of the discussions before such meetings as that of matters of trade moment in which they were all equally interested. (Applause.) Mr. Bell was thanked by the President for his paper.

On WEDNESDAY, when the business was resumed, the secretary read a list of the retiring members, all eligible for re-election, and then the thanks of the Institute were given to the ironmasters of South Staffordshire, East Worcestershire, and Shropshire for the manner in which they were entertaining the Institute, and to the committee at the Dudley Mechanics Institute for the use of the rooms of the Institute during the meeting.

Mr. BELL, vice-president, in supporting the votes, remarked that himself and others from the North were deeply impressed with the great warmth of the reception that they were receiving. The members of the Institute were getting so used to warm receptions everywhere they went, that he was afraid they were habituating themselves to them, taking them as a matter of course. Hence it, perhaps, became necessary to call the meeting's attention to their indebtedness (laughter) to gentlemen who favoured them with invitations. (Applause). The President then called for a discussion upon the blast-furnace papers, read on the previous day.

Mr. JONES thought that Mr. Gjers gave undue prominence to the stimulus given to the increased size of the Cleveland blast-furnaces by the alteration in the Whitten furnaces, inasmuch as, if he (Mr. Jones) was not mistaken, the alteration of the Thornaby furnace preceded that of the Whitten. Further, in this matter of large furnaces it should not be forgotten how much they were all indebted to Mr. Archibald Slade, of that town, who at an early modern date put up a furnace at Jarrow 60 feet by 18 feet 6 in. (as large in capacity as the Whitten Park Furnace) for working the Cleveland ore. Mr. Slade was the first to speak of the furnaces of these large capacities. In the early part of 1839 Mr. Snelus brought the subject under his attention.

Mr. GJERS replied that he gave the dates as they were supplied to him by the several firms mentioned, and he thought that he was right in dating the remodelling of the furnaces from the changes which were made at Whitton Park.

Mr. VAUGHAN, encouraged by the Whitten Park alterations, enlarged one of his furnaces at Middlesborough to 75 feet.

Mr. FOTHERGILL remarked that on the day before they had an admirably written paper from Mr. Whitwell, to whom special credit was due for having enabled the iron trade to accomplish so much, and save so much as was possible with the aid of his hot-blast stoves. At the same time he had learnt that whilst very high temperature had been secured that temperature was not always the most economical in respect of the quantity of iron produced, but in one case his friend, Mr. Bell, had been consulted, had recommended a lower blast, the recommendation had been adopted, and better results followed. Now, it would be of great interest and much good to the trade to know what was the benefit, if any, that resulted from increasing the temperature from 1000°, to which it could be got with the iron pipes, up to 1400°, to which it could be heated by Mr. Whitwell's stoves. He should very much like to hear Mr. Bell upon that subject. (Hear, hear.) A better authority he did not know, nor was his readiness to impart to others the immense store of information less remarkable than the extent of that store. To him Mr. Bell's great liberality and trade patriotism appeared something marvellous. (Applause.)

Mr. E. WILLIAMS likewise desired some information from Mr. Bell. His enquiry related to the economy of fuel. To him it seemed that there was a great deal of unnecessary information taught as to the last, and that information did not lead to economy. What in his opinion had to be done was for the escaping gas to be caught, that it might be ascertained what was its chemical composition. ("Hear, hear," from Mr. Bell.) If it contained a large quantity of carbonic acid they might be sure that the furnace was working with a small amount of coke, but if the gas contained a large amount of carbonic oxide then they might be certain that they were using their coke wastefully. (Mr. Bell: "Hear, hear.") The means of testing the economical use of coke was very simple indeed. It was merely to catch a small quantity of the gas, ascertain what proportions it contained of carbonic acid and carbonic oxide respectively, and measure the sensible heat of the escaping column. (Hear, hear.) Another point that should, he thought, be considered was the question of capacity. In his view the increased economy of the modern blast-furnaces was due more to height than to capacity. Without the height the increased capacity would not have been affected.

Mr. I. LOWTHIAN BELL then went fully into the subject under consideration, although he said he feared that some of his brethren upon the council, and others, would begin to regard him as a "bore" upon this theme of a blast-furnace. ("No, no.") It was, however, a subject of the utmost importance, because it went at once to the great question of the day—the economy of fuel in the blast-furnace; and it became them to approach the matter in the most philosophical spirit possible. He was inclined to think that the question of the great enlargement of blast-furnaces was retarded for some time by the want of information upon the subject; and he was disposed to agree with Mr. Gjers, that the results of a great deal of the enlargement of furnaces were not of that satisfactory character to induce anyone but a bold man to undertake the erection of furnaces 75 feet high. His own experiments began at a cubic space of 3000 ft.; then they went up to between 4000 ft. and 5000 ft., and subsequently to 6000 ft. In fact, he built a furnace 50 ft. high. The question was, had there been sufficiently beneficial results to justify this great advance? He must say that he had failed to see the beneficial results of a great deal that had been done. It was only when they doubled the size of the furnaces that they succeeded in obtaining the economy in the use of the coke that was now so well known to the members of the Institute. He was inclined to concur with his friend, Mr. Williams, as to the results to be obtained from high or low furnaces respectively. In low furnaces they got irregularities of working from which in the higher furnaces they were free. They must, therefore, have high furnaces. As to the the testing of the working of the furnace, that gentleman put the matter in exactly the right light. If one were to talk for a twelvemonth the point could not be put better than Mr. Williams had put it in the few words he had used. His friend, Mr. Whitwell, had attempted to draw around him a sort of *cordon sanitaire*. Mr. Whitwell had tried, very much against his (Mr. Bell's) will, to separate him from gentlemen of a purely practical turn of mind, whereas his own desire had all along been to be rather the practical than the scientifie man. (Hear, hear.) He (Mr. Bell) then went on to explain, having been consulted as to the Consett furnaces, he had after making experiments remarked that although the proprietors might enlarge the furnace as they intended, yet that the result would not be satisfactory. A furnace was, however, enlarged, and he was sorry to say did not work so well as before. Mr. Jenkins was kind enough to ask his opinion, and his reply was that the extreme heat of the blast was to blame. The heat of the blast was reduced, and Mr. Jenkins had informed him that they had reaped benefit from the change. When he (Mr. Bell) was consulted there was a problem to be solved, and he contended that he solved it. His friend, Mr. Whitwell, had rendered the proprietors of the Consett furnaces great service. He had said it before, and he repeated it now; but as they had a limit upon the further advance of the furnaces in the Cleveland district, so also, he contended, had the Consett gentlemen a limit upon theirs. Mr. Bell further addressed himself to Mr. Whitwell's paper, and maintained that that gentleman had proved too much. The model with which Mr. Whitwell had illustrated his paper, Mr. Bell contended, could not show them what was going on inside a furnace, for all the portions of the charge went into it and came out of it the same size, whereas it was his (Mr. Bell's) conviction that, whatever might be the shape assumed by the coke and the limestone, as to the ironstone that occurred which they saw in the operations of slaking lime, the stone became pulverised, broken up into impalpable powder. These might be the sentiments of a theoretical man, but it was also the experience of a practical man. (Applause.)

Mr. WHITWELL, adverting to the question put by Mr. Fothergill, explained that, owing to some change in the management, a furnace at Consett had been put to work iron for which it was not originally intended. For the purpose to which the furnace was now being put he did not say it was the best adapted. As to the remarks that Mr. Bell had made relative to the notice of him which the returns he (Mr. Whitwell) had obtained from the furnace records justified him in penning, he was sorry if he had written anything that was improper—("No, no," from Mr. Bell)—and if he had transgressed the rules of the Institute in any way—(Mr. Bell: "No, no")—he hoped Mr. Bell would pardon him. (Hear, hear.) He (Mr. Whitwell) then went on to contend for the accuracy of his paper, and for the correctness, as far as was possible, of his model.

Mr. RAMSAY, who was called upon by Mr. Bell because he had just blown-in a furnace with a superheated blast, said he concurred with some of his friends who rejoiced that they were to have no more furnaces in Cleveland. (Laughter.) He spoke of the great economy which resulted from early experiments which he conducted at Jarrow with strong blasts, such as a pillar of 4¼ lbs. Instead, as his neighbours had anticipated, blowing the boshes out, and the whole contents of the furnace into the air, the result was that they made No. 1 iron for two months running. That was a wrinkle—(laughter)—and he had ever since tried to get plenty of blast. Hot-air stoves he had had burnt over and over again, and he need hardly say during the night shift. (Hear, hear.) This had now, however, been decided by Mr. Whitwell, with whose stoves this did not occur, and which, moreover, enabled them to get a blast, as at Consett, of, he supposed, 1400; and their belly-pipes were very hot indeed. They had had beautiful instruments for measuring the heat, but they were all beaten by the extreme height of the Whitwell stoves. That heat enabled them to use stone containing a very low percentage of iron, yet to produce a pig that much gratified the puddlers. All this was done with 20 cwts. of coke to the ton of iron. Other beneficial results were to be looked for, Mr. Whitwell had told him, from a greater draught. Mr. Whitwell should have an opportunity of proving that much. As to the exact heat of the blast they were getting from the stoves of Mr. Whitwell, whether it was 1400° or 1150°, to which point alone the instrument of Mr. Siemens went up, he was not very careful to get determined, for he felt the wisdom of the remark of his furnace manager, who said, "So long as you get your belly-pipes red-hot." (Loud laughter and applause.)

Mr. BAGNALL, responding to the Vice-President, spoke with satisfaction of the working of his furnaces in the Cleveland district, where they were an exception to all the rest, inasmuch as they worked with open tops, upon the principle of Mr. Adenbrooke. In the last quarter, however, their consumption of coke was 23¼ tons per ton of iron. It was an increase upon the previous quarter of 1 cwt. per ton. He attributed the difference in the two quarters to inferior coke, arising out of the great demand the coke-burners now experienced for their product. As to the temperature, he was now anxiously investigating it, for he wanted to put up a new stove. At present they got about 900°, and it varied sometimes 100° in the course of the week, which, he thought, sadly too much. They used 27½ cwts. of raw stone of a lean quality, and a little forge cinder to the ton of iron. As to the size of the furnace-throat, one was wide and the other narrow. In the wide economical results followed upon having the materials carefully and evenly spread in the charging. In the narrow throat this operation was unnecessary. Therefore, he quite agreed with Mr. Whitwell as to the great necessity of charging the materials properly at the top of the furnace. (Applause.)

The PRESIDENT then called for the reading of the remainder of the papers.

ON THE COMPOSITION OF THE GASES EVOLVED FROM THE BESSEMER CONVERTER DURING THE BLOW.

Abstract of Paper by Mr. GEO. J. SNELUS, Associate Royal School of Mines.

This investigation was undertaken in the hopes of solving some of the difficulties connected with the spectroscopic observation of the Bessemer flame, and also as likely to afford a further insight into the nature of the process going on in the converter.

The gas was collected for analysis by means of an iron gas-pipe, having a swan-necked trumpet mouth-piece of fire-clay, which was dipped into the mouth of the vessel after it had been turned up. The gas, from its pressure in the converter, rushed through the pipe with some velocity, and after the whole of the air had been swept out glass tubes were attached, and when filled with gas, at particular periods of the blow, were hermetically sealed up with the blow-pipe before removal. The gas was analysed in some cases by two different methods, and the duplicate results were found to agree.

The following tabular statement shows the composition of the gas at different periods of a blow lasting 18 minutes:—

	No. 1. Taken 2 from start.	No. 2. 4'	No. 3. 6'	No. 4. 10'	No. 5. 12'	No. 6. 14'
Carbonic acid	10·71	8·57	8·2	3·58	2·3	1·4
Carbonic oxide	None.	3·95	4·52	19 59	29·3	31·11
Oxygen	·92	—	Absent.	Absent.	None.	None.
Hydrogen	88·37	·88	2·00	2·03	2·16	2·00
Nitrogen		86·58	85·38	74·83	66·24	65·35
Hydrocarbons	—	—	—	—	None.	—
Total	100·00	100·00	100·00	100·00	100·00	100·00

On dissecting these results, we find that the oxygen corresponding to the nitrogen in No. 1 is sufficient to oxidise not only the 4·43 parts by weight of carbon that are contained in the gas, but also 11·91 parts of silicon, and as these two bodies are practically the only ones being burnt from English Bessemer iron at this period of the blow, we may take it that these are actually the proportions in which carbon and silicon are now being got rid of from the metal. And this is exactly what analyses of the metal at this stage show, for it was found in one instance that metal containing 3·57 parts carbon and 2·26 silicon at the commencement lost ·53 parts of carbon against 1·305 parts of silicon in the first few minutes. Analyses of the gas from another blow about the same time, made by W. Thorp, F.C.S., of the River's Commission Laboratory, show practically the same results. Sample 3 shows that 5·27 parts of carbon are being burnt along with 11·74 parts silicon. Sample 4 was taken after the commencement of the "boil" when the complete carbon specimen had become permanent. It shows quite a different result from the previous analysis, the large percentage of carbonic oxide now present explaining why the flame has become so much more luminous. We now find that 9·6 parts of carbon are being oxidised along with 6·25 parts of silicon. Sample 5 was tested specially for hydrocarbons, but none were found. Sample 6 shows that 13·45 parts of carbon are being burnt at this period, and only ·46 parts of silicon, which corresponds with analyses of the metal, these proving that the last traces of silicon goes off very slowly.

The author considers that the reason why carbonic acid is formed during the first part of the blow, and carbonic oxide at a later stage, is to be found in the increase of temperature during the blow. This agrees with experiments of Mr. Bell, who proved that at a low temperature carbonic acid was more stable than carbonic oxide *in contact with iron*, but that at a high temperature the reverse was the case. It also agrees with general observations. As a general result the comparison of the gas analyses with spectroscopic observations shows that the reason why we get a continuous spectrum at the commencement of the blow is that we have then only white-hot solid matter to look at, there being no actual flame, and the temperature being too low to give the specimen of carbonic acid, while later in the blow we have an abundance of carbonic oxide burning at the mouth of the vessel, which is also at a very high temperature, and, therefore, we get a carbon spectrum which is distinct from other carbonic spectra yet seen, because we have not yet been able to examine the spectrum of carbonic oxide at the particular temperature of the Bessemer flame. Mr. Snelus believes that Deville's theory of the increased luminosity of flames under great pressure, being due solely to the increase of temperature, is applicable to the great luminosity of the Bessemer flame compared with that of carbonic oxide burning at a low temperature. On comparing the gas from the Bessemer converter during the latter part of the blow with blast-furnace gas, and with analyses of gas from Siemens' producers given by the writer, it is seen that the former is as valuable a fall as any of them, and as a works using 1000 tons of pig per week is sending this gas to waste at the rate of an equivalent of 25 tons of coke per week its economical application becomes a point of great importance. The writer believes this could be accomplished in a simple manner.

The PRESIDENT said that such a paper as they had just heard from Mr. Snelus was especially necessary in a new manufacture. The document contained a great deal of information that would ultimately be found of great importance. It was with great pleasure that he saw so much scientific knowledge, and so much patient investigation, devoted to a subject in which he and so many gentlemen present were so much interested. (Hear, hear.)

A cordial vote of thanks was passed to Mr. Snelus, the author.

DESCRIPTION OF DANKS'S PATENT REVOLVING PUDDLING-FURNACE.

BY MR. SAMUEL DANKS, OF CINCINNATI, OHIO, U.S.A.

The author stated the experiments were commenced in the Cincinnati Railway Ironworks in May, 1868, with a small revolving furnace to puddle from 250 to 300 lbs. per heat. Successful results being obtained, two larger furnaces were built, and were got to work in April, 1869, since which period they have continued in regular operation, and are now at work. Several improvements have, however, from time to time been made in them and adopted. In April, 1870, the above company, finding that the work and results obtained were satisfactory, ordered the removal of all their old hand puddling-furnaces as fast as the revolving ones could be erected. They are now puddling exclusively with the machine puddlers, and are making puddled balls 700 lbs. in weight. In February, 1871, the Roane Iron Company, at Chattanooga, Tennessee, commenced working a 700-lb. furnace, and contracted for 10 more. Particulars were given by the author of the various works in the United States, where the revolving puddling-furnace has been adopted, among which are the Ohio Falls Company, New Albany, Indiana; the Jones and Lauglin Works, Pittsburgh, Pa.; Akins Brothers Works, Pottsville, Pa.; the Indianapolis Rail Mill Company; and the Atalanta Rolling Mill Company, Georgia; and at all these establishments it is asserted that the machine has worked very satisfactorily.

The furnace has a fire-grate in outward appearance like the ordinary puddling-furnace, but it differs from this considerably in several particulars. It is supplied with a fan-blast under the grate to urge the fire and produce gas. It has also jets of fan-blast over the fire injected for the purpose of ensuring the more perfect combustion of the fuel. This blast is regulated by a valve, by which the workman has a perfect control of the quantity of gas generated and consumed, and is thus enabled to make the temperature suit the requirements of the charge in the different stages of the puddling process. The ash-pit and fire-hole are closed by doors to prevent the escape of the blast except through the fire, and the fire-hole has a coil of wrought-iron water-pipe cast into it for the purpose of allowing a stream of water to circulate around it to keep it cool. A similar coil is inserted in the bridge-plate between the fire and the charge of metal. Fastened on to the bridge-plate is a ring with a flat surface on one side, which ring has a pipe, or pipes, cast into it, and is made in one piece, or in sections. This forms a butt-joint with the revolving part of the furnace. The face is cast on a metal chill to harden the part exposed to abrasion from the end of the revolving chamber rubbing against it.

The revolving chamber is made of two end-pieces, so formed as to be banded together with wrought-iron bands, and to have detachable rings on the part most exposed to the fire. It rests on carrying-rollers to allow its free rotation, and has also suitable ribs for strengthening it, with holes for rivetting the rings and stave-plates upon it. The two ends are connected together by a series of stave-plates to form a cylinder, and are of suitable length, according to the desired size of the chamber. They have hollow ribs running longitudinally, which serve the double purpose of holding the fettling and keeping it cool, and when rivetted together form an open-ended cylinder, one end of which butts against the ring that is fastened to the bridge-plate, where the gases are admitted over the bridge from the grate, and the other open end serves the purpose of a doorway for the reception of the charges of iron, and also for their removal, as well as for the escape of the products of combustion through a movable headpiece, which connects the revolving chamber and the chimney. This piece can be moved at pleasure, by means of a suitable apparatus overhead, and when in its place for puddling the escaping gasses pass through it into the stationary flue, and thence to the chimney or boiler. When adjusted for puddling the piece is

held in position by suitable props, and balls of great weight can be removed from the furnace very readily, the ends being open. It has also an arrangement of water pipes for keeping it cool, and a stopper hole in front, so that the operations going on can be seen at all times.

The vessel is made to revolve by means of a toothed wheel fixed longitudinally upon it. A suitable engine is attached to each machine, so that the chamber can be made to revolve at any speed that may be required, according to the different stages of the operation. The most important feature in connection with the invention is the lining of the vessel. The foundation consists of what is termed the "initial" lining, which is composed of a mixture of pulverised iron ore and pure lime, worked with water into the consistency of a thick paste. The method of putting on this "initial" lining is fully described, and when completed the author says that upon it is placed the fettling proper. A quantity of pulverised iron ore, about one-fifth of the total amount required to fettle the apparatus, is thrown in, the furnace is heated and made to revolve slowly until the iron is found to be completely melted, and the apparatus is then stopped. That part of the molten iron which has not been consumed by glazing the "initial" lining surface runs to the lowest level of the furnace, and then forms a pool, into which there are put a number of small and large lumps of iron ore, of such dimensions as will be required to allow the said lumps to project over the surface ore by from 2 in. to 6 in. This part of the fettling is allowed to set, when a fresh quantity of pulverised ore is thrown in. The furnace is again made to rotate slightly, until the newly-added ore is liquified, when the apparatus is again stopped, and the pool is filled with lumps as before. The operation is continued in this way until the whole of the vessel is properly fettled. From 2 to 2½ tons of iron ore are required to fettle a 700-lb. furnace. The iron is charged into the furnace either in a solid or molten condition. When charged in the shape of pig-iron the melting down occupies from 30 to 35 minutes, during which a partial rotation is given to the furnace from time to time, in order to expose equally all sides of the charge to the flame.

When the whole of this is thoroughly melted the furnace is made to rotate once or twice per minute only during the first five or ten minutes, in order to obtain the most perfect action of the cinder upon the molten iron. A stream of water is injected through the stopper-hole along and just above the line of contact between the floating cinder and the inner surface of the vessel on the descending side. A certain portion of uncontaminated cinder is thereby solidified on the metal surface, and is carried down into or below the bath of molten iron in a continuous stream, which, in rising up through the iron, combines with the impurities of the latter in a far more effectual and complete manner than any mode of puddling hitherto known can effect. On the expiration of the said five or ten minutes the iron begins to thicken, and the motion is stopped. The heat is then raised so that the cinder shall be perfectly liquified, and the vessel is brought into such a position that the tap-hole shall be just over the level of the iron, which by this time has become partly pasty. The puddler gently pushes back the iron, and the cinder is made to run off. The heat is again raised, and the furnace is put in motion at a velocity of from six to eight revolutions per minute, by which means the charge is dashed about violently in the furnace. A high temperature being kept up, and the charge being continually turned over, the particles begin to adhere, when the velocity of the apparatus is lowered to from two to three revolutions per minute, upon which the ball then very speedily forms. The puddler then solidifies the front end of the ball by a few blows from a tool, applied through the stopper-hole. The props of the movable piece are then removed, and the flue hanging over the overhead rail is moved away. A large fork suspended from a crane is put into the vessel along one side, and the ball, which by a turn of the vessel is rolled on to the fork, is then taken out by means of a crane. The ball is then worked in a squeezer. The flue is replaced after the requisite quantity of cinder and metal have been again charged, and the process is continued. From eight to ten charges are made before any re-fettling is required, and these heats are worked in a day of ten hours. The writer gave results that have been furnished to him as obtained at different works by the use of revolving puddling-furnaces. The following may be taken as a sample of these. Puddling cold pigs charged at the Cincinnati Railway Works for week ending July 8, 1871 :—

164 heats, 6000 lbs. each	110,400 lbs.
Product of rail tops	116,811 lbs.
Gain	6,411 lbs., or 5 8 per cent.

Time, five furnaces four days, and four furnaces one day. A day lost in consequence of the national holiday, on July 4. Week ending July 15, 1871 :—

218 heats of cold pig, charged 600 lbs. each	130,800 lbs.
Product (tops)	136,934 lbs.
Gain	6,134 lbs., or 4·68 per cent.

Furnaces at work—four for two days, five for three, and six for one day. Quality of pig used—half inferior, weak, cheap, and half fair charcoal. Thermometer ranged above 90° during the above period, and most of the ordinary iron working had to be stopped a part of the time. The excess of product over the weight charged is caused by the richness of the fettling used. Mr. Danks claimed for revolving furnaces the following advantages :—A great saving in the cost of labour and also in the consumption of coal, varying according to the size of the furnace ; a superior and more regular quality of puddled iron from a given quality of pig ; a yield of puddled iron much in excess of the charge of pig metal instead of the usual loss, the extra yield being obtained by the reduction of the rich fettling used in the machine ; eight to ten heats, whether of from 5 to 10 cwts., are made in a day of ten hours, when suitable metal is used ; the refining process is very complete, the whole of the phosphorus and silica and sulphur to a large extent being removed by the chemical action of the lining mixture ; the very heavy and exhaustive labour of puddling is performed by steam-power, thereby enabling one skilled man to attend to the working of a large quantity of iron ; the bringing to nature and balling of the iron is completed by the rotary action without the use of rabbling, except when the heat has to be divided into smaller balls, and the capacity may be suited for heats of any weight from 5 cwts. upwards. The cost of the furnace, weight of product considered, is about the same as that of the usual hand-puddling furnaces.

In order, however, that these advantages may be obtained to their full extent by the use of this new form of puddling-furnace, it is essential that the whole of the arrangements connected with the manipulation of the iron may be upon a suitable scale.

It is almost needless to say that the existing arrangements for hammering and rolling puddled iron would not be suitable, where such large masses of puddled iron have to be dealt with. In proportion as the subsidiary appliances are carried out upon a proper scale, so will be the advantageous results obtained from the puddling apparatus. As a further evidence of its undisputed success in America, the Great Industrial Exposition, held in Cincinnati, in 1870, awarded a special gold medal to the writer "for his valuable invention," and this award was made after the judges on that class of machines had personally witnessed its great success in doing all that he claims for it, and who were previously sceptical of the possibility of such yield and quality of product, and also of such a saving of materials as they saw effected in the furnaces.

When the Secretary had finished reading Mr. Danks's paper, the PRESIDENT said that the importance of the paper merited the best attention the meeting could give to it, and he asked for observations from practical men, suggesting that perhaps Mr. Menelaus would begin the discussion. The meeting responded by calling for Mr. Menelaus.

Mr. FOTHERGILL said he thought that, perhaps, he might say something which would lead up to some detailed observations by that gentleman. He was so fortunate as to be asked by Mr. Menelaus to see his rotary furnace at the time when it held out so many prospects of success. At that time there were two difficulties which Mr. Menelaus had not conquered, and he (Mr. Fothergill) was unaware that he had yet conquered them. Mr. Menelaus had introduced the pig-iron into the rotary-furnace, and he had produced in his presence a very large and apparently a very satisfactory ball of iron ; but it appeared to him (Mr. Fothergill) that the fettling around the furnace seemed to get continually dislodged and broken as the contents assumed the malleable condition, and rolled about in the stage towards completion. This breaking and dislodging of the lining of the furnace constituted the first difficulty. The second arose out of it, and it was this. Ganister being the fettling material, it followed that in its dislodgment and melting it mixed with the iron in the furnace, and deteriorated its quality. Thus, not only was the furnace broken down, but the quality of the iron was broken down also. After what he saw of the difficulties with which his friend, Mr. Menelaus, had to contend, and his inability with all his experience to overcome them, he admitted that he read with only little interest that a new rotary puddling-furnace was to be brought under the notice of that meeting, notwithstanding the great importance of the question to the whole iron industry. He must, however, confess that he had listened with the greatest possible interest to a paper which dealt with a machine in which the breaking down of the fettling was not only no injury to the iron, but was positively beneficial to the yield. He could not, therefore, refrain from drawing attention to the singular value of such an invention, if its claims could be supported.

Mr. E. WILLIAMS remarked that it was necessary to waste one word in endeavouring upon that occasion to show how necessary it was that they should have a mechanical puddler. Steeped as he was to the lips in this mechanical puddling difficulty, he should hail with immense delight anything that should provide them with an efficient furnace, even though the cost should be much more than the present apparatus. (Mr. Fothergill, "Hear, hear.") Unless mechanical puddling was accomplished, it would be by-and-bye impossible for them to get their puddling done at all. (Hear, hear.) As to whether the invention now brought forward was new, that they might leave to others. With patent rights and priority of invention that meeting had nothing to do, but it was of importance for them to consider whether such a machine as was now presented to them was so different from what had been already tried as to offer hopes of success. (Hear, hear.) For himself, he did not very well see in what material point this machine differed from the Dowlais machine, which had had a great deal of time and money expended upon it, and which had been managed by one of the ablest, if not the most able, ironmasters in the kingdom. (Hear, hear.) That being so, it was rather disheartening that another machine should be brought forward which did not differ from the Dowlais furnace. The Dowlais machine made excellent puddled balls, but, as Mr. Fothergill had said, the quality of the lining marred the whole thing ; and he (Mr. Williams) felt quite confident that Mr. Menelaus would not hesitate to say that the difficulties fairly beat him. That gentleman had not, however, exhausted all his ingenuity. ("Hear hear" from Mr. Fothergill.) If Mr. Menelaus should try again, he would try something better, and if he did he would accomplish with his machine the same that had been accomplished with this. His (Mr. Williams's) own opinion was it was a mistake to go for thick lining. He did not see how the thick lining was to be made to stand. Than a rotary puddling-furnace they could not devise a more efficient machine for breaking up the lining of any hollow body than a heavy mass of irregular-shaped iron rolling about within it. It was his view that a thin lining, having the assistance of water or some other cooling appliance on the outside, perhaps, was better than a thick lining. He did not wish to be regarded as discouraging Mr. Danks, but looking at the machine with a puddler's eye, and with the knowledge he possessed, he did not see anything in which his machine differed from what could be brought about with the Dowlais machine, with Mr. Menelaus at the end of it.

Mr. BELL said that he reciprocated the sentiments which advocated puddling by machinery instead of by hand-labour. It was many years since he had anything to do with puddling, but he remembered enough to make him sympathise with those who desired to have a steam puddling-furnace. If he had forgotten anything, circumstances, moral and physical, every day reminded him of the necessity of puddling by machinery instead of by hand. But they must not be too ready to resort to that which promised the advantages desired. They should be first satisfied that it could afford them the help they needed. He saw by Mr. Danks's paper that the machine was at work at irregular periods. The record was, "four machines two days, six one day," and so on. He should like Mr. Danks to inform them why the furnaces in these cases were not at work six days and not two days, or one day or four days. It seemed to him that these irregular periods pointed to the difficulties to which attention was drawn by Mr. Williams with regard to the fettling. Still they must be careful not to throw any disparaging remarks upon any invention brought before them, for, as he had before observed, he regarded the Institute as a kind of filterer through which all new inventions must be made to pass. (Applause.) At the same time gentlemen who brought such questions forward must expect questions to be put to them. (Hear, hear.) He found recorded in the paper that certain quantities of pig-iron were put into the furnace, and yet that when it came out of the furnace it yielded a greater weight of puddled iron. He need not remark how unlikely it would be for any iron in the North of England, not to speak of Staffordshire, to yield 8½ per cent. more after it had passed though the puddling-furnace than before it went into it. The inventors would tell them that this was due to the reduction of the very rich fettling. But it happened that whilst 9680 lbs. of pig-iron was being used 1500 lbs. of ore was used. It would not be difficult to calculate that that was equal to a gain of 316 lbs., which upon the 1500 lbs. gave them 54 per cent. He was quite willing to admit that ore could be reduced in a puddling-furnace, but he was not quite sure that so much as 54 per cent. could be got out of any ore by the action of a puddling-furnace. (Hear, hear.)

Mr. KITSON said it appeared to him that this was a question of fettling. Mr. Menelaus used ganister. That fettling had been tried in the ordinary furnaces with the same result. It might be that Mr. Danks had secured some kind of iron ore fettle that made his furnaces a success. Had he seen in England anything similar to that which he had used in America ? Mr. Williams had seriously discouraged investigation in this matter. Mr. Danks had, however, asserted that in the past week 70 tons of iron had been produced out of his furnace. It seemed to him (Mr. Kitson) that this was a question which they ought to investigate. (Hear, hear.) It would be very easy to do so. Considerable sums of money had been secured by the Council, and it was quite open for consideration whether it would not be well for the Council to take this machine, and putting it into practical hands, investigate it for the benefit of the Institute. (Applause.)

Mr. MENELAUS said that he tried, and tried hard for years, but he failed to secure satisfactory results. He experimented with all kinds of lining. Ganister, he found, was that which stood the best, but it had the worst effect upon the iron. Now, however, Mr. Danks came and told him that he had just taken the one step that he (Mr. Menelaus) had been unable to take. He was quite sure that no man in England would give Mr. Danks greater credit than he (Mr. Menelaus) would, or would throw up his cap, if Mr. Danks succeeded in doing that which he failed to do. If Mr. Danks had achieved that which they all so much desired they would all be glad, and would adopt the invention. He offered to put up one of Mr. Dank's machines, and to do so effectually, so that the entire method might be fully tested. This, however, involved the erection of the squeezers, which involved considerable outlay. Hence a mercantile consideration was involved, and a difficulty that, although Mr. Danks had been for some time in this country, was not yet disposed of. He (Mr. Menelaus) was willing to enter into a bargain with Mr. Danks, but if they went on haggling they should be a long time before they arrived at a satisfactory result. The matter had been discussed that morning in the Puddling Committee, and his friend Mr. Williams suggested that they should send a deputation (say) of two practical men over to America, to see what the machine was doing there, and what it was likely to be made to do in this country. It had also been suggested that the funds in the hands of the Puddling Committee should be used for the purpose. He could only say that as to the deputation going over to the United States he quite concurred, and that if it should not be thought well to spend the money of the Institute, then that, with the aid of one or two spirited gentlemen, the deputation might be sent out without cost to the Institute, but all the information that was obtained should be at the service of the Institute. (Applause.) He the more approved of such a step as sending representatives to America, because, without at all disputing that Mr. Danks had accomplished all to which he laid claim, he could not forget that some time ago an American inventor was at the Dowlais Works for about a year, and received all the help that they could afford him, yet he was unable to make anything else than a miserable failure of that which it had been said was a splendid success in America. It would be well, he thought, if representatives be sent to America. (Applause.) In that case the whole affair would be fully known to them in the course of two or three months. (Renewed applause.)

Mr. WALTER WILLIAMS wished to know whether the stone that Mr. Danks used was anthracite, and whether the ore was magnetic ? He had in his possession the whole drawings of a mechanical puddler, but a friend had just written him from the States, saying "Withhold your judgment on the mechanical puddler ; Danks, a man in Cincinnati, has got a complete success." He (Mr. Walter Williams) did think that Mr. Danks was very much in advance of anything that was before done. With regard to thick fettling, he had expressed himself the day before to the effect that no furnace with such thick fettling would succeed, and he was glad to find that Mr. E. Williams adopted his views, but if Mr. Danks would tell the meeting that the fettling and the stone were to be used he should be helped in their investigation. Sending out a commissioner was the best thing they could do. (Hear, hear.)

Mr. DANKS now came forward, and was received with cheers. He said that, inasmuch as he was not accustomed to speak before an audience such as was then before him, he feared that he might not be able to answer consecutively the questions that had been put to him, but he would do his best. He would guarantee any committee sent by the Institution, or by anyone else, should have every facility for testing with every kind of ore they chose ; they could weigh in coal and iron ore, and witness the workings ; they could also take with them as many practical puddlers as they wished. Similar investigations to those now suggested had been made in America. The suspicions had been the same there as they now were in England. People ask—"How can you make so much iron as you state ?" His reply was that he did not make it. They had obtained an average, with his furnace, of 50 per cent. of iron. Sometimes the yield was 15 per cent. over the pig-iron, but with a pig-iron similar to that which in the South Staffordshire district was called "mine metal," the average yield in excess of the charge was 6 per cent. As to the fettling, he had to say that what was needed was an ore that contained not more than 5 per cent. of silica. In America they had a mountain ore, in which the average of silica was 5 per cent., though there were individual samples that possessed only 1 per cent. Any ore with 5 per cent. of silica would answer the purpose. There was a Norwegian iron ore that he had seen in this country which contained even a smaller portion of silica than 5 per cent., indeed contained, some of it, hardly a trace of silica. That ore, he thought, would be available for the British ironmasters. The purer the ore was from silica the harder it was to melt. It was necessary to the correct working of his furnace that it should melt at a very high temperature. They melted at a temperature very much higher than could be got in a hand furnace. This was possible, because of the use of steam. The quality which the furnace turned out was far superior to that which could be got from a hand furnace. They removed every trace of phosphorus. The silica and the phosphorus combined perfectly—much more so than could be effected in the hand furnace. Every particle of the lining of the furnace was left ; in this way they got their yield. He believed that if the average were taken from the beginning of the use of the machine, the average yield over the pig-iron put in would be 9 per cent. As to the difference in the periods of working of the furnaces to which Mr. Bell had drawn attention, the explanation was that at the different works, and where the furnace had been adopted, they were set to work in fours, or twos, or ones, as the case might be, and they had been at work for the days set against them at the time when the report was drawn up. At the Cincinnati furnaces he built first a small one, which worked so successfully that the company ordered him to build two large ones, producing the same quantity as the hand furnaces. These machine furnaces run a race for hearly two years with the old hand furnaces. In hot weather, whilst the hand furnaces could work only two or three turns a week, the machine furnaces made from seven to eight ; and whilst the yield of the former was from 15 to 20 cwts., the yield of the latter was from 40 to 50 cwts. Further, when the bars were put alongside eight others upon the bar bank, there was as great a difference between the two as between light and darkness. On his recommendation the company, after these experiments, made extensive advances in the use of the machine, and he, to secure fair treatment in its work, got intelligent, though working, men to assist in its management. He chose men even off the road, if they were intelligent, in preference to puddlers, who were prejudiced, and he made good puddlers of some of them in a month. Respecting the thickness of the lining, it was a great mistake to suppose that a thin would be a better than a thick lining. He said, on the contrary, that the thicker the fettling the better, and he spoke what he knew. The artificial bottom was intended solely to keep off the heat from the real bottom of the furnace, and so to prevent it from melting. A thin lining could not accomplish this. The fettling he used was composed of pulverised iron ore and lime, mixed up like mortar. It was applied in that consistency, and when it was hard they might fire away at it till doomsday, but they would not melt it. The initial fettling he used, but they also used an inner lining of melted iron ore (chunks of ore were the best), which answered the double purpose of breaking up the iron and increasing the yield. In accounting for the 50 per cent. of yield obtained from the lining of the furnace, it was omitted to be stated that the puddlers obtained large quantities of roll, scale, and cinder, obtained from the rail mills, where old rails were straightened and cut. Sometimes they had 350 lbs. weight of fettling in one day, from which they produced as much as 300 lbs. weight of puddled iron. He knew of nothing that removed the silica and phosphorus from the iron so readily as this machine did. He had never made so good a quality of iron as from this machine. All kinds of iron had been tested in it. People in America had brought iron thousands of miles with which to try the capabilities of the furnace. The committee of the Institute might take Cleveland iron with them to America and test the furnace with that material. They might take as much as they liked, or any quality they liked, and every assistance should be given for them to arrive at a most accurate conclusion. The very man (Mr. Louis) who drew up the report upon which his paper was founded was as sceptical as anyone in that room. Mr. Louis came to him and said, "Mr. Danks, I do not believe it, and I am determined thoroughly to examine it." He did thoroughly examine it day following day, weighing in all the coal and the materials, excepting only the mill scale, and watching all their operations with the closest possible attention. This he (Mr. Danks) mentioned as only one instance of the prejudice entertained, but irresistibly overcome, which had attended the operations of the machine. "There is no more doubt about it," concluded Mr. Danks as he left the speakers' platform, "than that you are men." (Laughter, and much applause.)

A MEMBER enquired : Why not use tap cinder for the cinder bottom ? It contains only 2 per cent. of silica.

Mr. DANKS : That would do very well.

Other two papers were set down to be read at this sitting. They were, "On the Newport Puddling Furnace," and "On Howatson's Patent Puddling and Heating Furnace ;" the first by Mr. Jeremiah Head, of Middlesborough, and the other by Mr. Howatson, Brindley Ford, Congleton, Staffordshire. But respecting them the President said that the meeting would be unable to take them on that occasion.

The President tendered the cordial thanks of the Institute to Mr. Danks, not only for his excellent paper, but for the additional information with which he had now supplemented that paper.

A MEMBER desired to know if it was competent for him to propose that the expenses of the deputation to America, to examine the furnace, should be borne by the Institute ?

The SECRETARY (Mr. John Jones) explained that the Puddling Committee had had placed at their disposal any reasonable sum. Therefore, it was for the Committee to decide, when they had ascertained what would be the expenses, whether they would avail themselves in this way of the funds which they had power to command, or whether they would ask for more funds. But there was quite enough money for the Committee to do all that they required. (Hear,

Mr. WALTER WILLIAMS proposed, and Mr. HUNT (the Chairman of the South Staffordshire Iron Trade) seconded, and it was unanimously resolved, that the thanks of the Institute should be presented to Mr. Bessemer.

The PRESIDENT, in responding, said that he hoped during his time of office he should see very great progress made in that rising and very interesting institution. (Applause.)

The business sittings of the meeting were now over.

WEDNESDAY'S EXCURSION.—In the afternoon the visitors proceeded by special train to Round Oak, with the intention of inspecting the celebrated works of Lord Dudley, in that neighbourhood. The Earl of Dudley, accompanied by Mr. E. F. Smith, Mr. R. Smith Casson, Mr. W. Jeffries, Mr. Perrins, and Mr. Dudley, awaited the visitors, and when Mr. Bessemer, the President, had been presented to him, his lordship led the way to the sample warehouses, and from thence to the works, where Mr. E. F. Smith and Mr. Casson took charge of the party. After inspecting the works, a party proceeded to the blast-furnaces at the Level, and a second party went on to the celebrated Nine Locks Colliery, under the direction of Mr. William Jeffries. The furnaces in connection with Lord Dudley's works are probably the finest in South Staffordshire, and the modern improvements in blast-furnaces are all adopted. There are four furnaces, and another is being built. An effort to heat the boilers with the waste gases from the top of the blast-furnaces is nearly complete, and a stack, by far the largest in the district, has been built to draw off the said gases. This fine piece of masonry is 250 ft. high by 12 ft. in the square. The furnaces have been built of red brick, lined with best white brick, and cased with bands of wrought-iron. The works are fitted up with gas-piping, which is supplied by a small gasometer on the works. After the inspection of the works, the company assembled in a large tent specially provided, and here they were entertained at luncheon by the Earl of Dudley. About 350 guests sat down to a bounteous repast, his lordship presiding, supported by Mr. Henry Bessemer and Mr. Fothergill, M.P. (Aberdare). In proposing "Success to the Iron and Steel Institute," his lordship said he felt greater pride at being Chairman of that meeting than he had experienced for some time. He rejoiced in their visit, not only for social reasons, but because it was a time when ironmasters of South Staffordshire did not look with distrust upon visitors. (Loud applause.) Mr. Bessemer had told him that the society was a young one, but that during the past two years there had been a large accession to the number of members, thereby showing the truth as to the utility of the Institute and its meetings. He understood that the object of the Institute was the development of the mineral resources of the country, and no secular society could have a more beneficial object. (Hear, hear.) It had been stated that the hospitality shown in South Wales was of the highest kind, but he could only say on that topic that the feelings of the Welsh people were not stronger than those of the South Staffordshire ironmasters. ("Hear, hear," and applause.) But on that occasion they had met upon private grounds, and in a semi-private manner; the next day they would meet in that natural centre of the South Staffordshire district—the Midland metropolis, Birmingham—(applause)—and then the ironmasters would be able to pay a fitting tribute to the Institute. In conclusion, Lord Dudley coupled with the toast the name of Mr. Bessemer.

Mr. BESSEMER, in responding, remarked upon the occasion which had brought them together, and said he felt proud and honoured in his present position, and impressed by the place in which he stood, for it was classical ground. It was near where he stood that the gigantic iron trade of England received its first impulse and development. If they went back to the time of Charles I., when the iron trade was in Sussex and Kent, and when the yield of iron in the country was but 70 tons annually, they would find that the people were dependent on the oak tree, which they husbanded to build their ships, not dreaming or caring for iron, they would see the rapid strides which had been made by the iron trade. (Hear, hear.) It was near the spot where he stood that an ancestor of the family of the noble lord attempted, and with success, but without profit, to turn the vast mineral resources of the country in which he lived to a practical purpose. Although he did not produce the best iron, what he did produce was of good merchantable quality, and that was a great stride beyond the simple charcoal iron, made in small quantities. But that day they had seen works equipped with every modern improvement, and they had seen iron of the best quality. They had seen, too, excellent mills, where the best iron had been manipulated, second to no class in the United Kingdom. (Applause.) In conclusion, he might say that he was only speaking the opinion of the Iron and Steel Institute when he said, that no better or kindly reception could have been given to them. (Loud applause.) He had the honour to propose the health of the Earl of Dudley.

His LORDSHIP, on rising, was warmly received. He said he was glad that they were emancipated from the time when charcoal iron was made, for then he should have been unable to entertain his visitors as he could have wished. (Applause.) He had that morning seen a lease given by one of his family, Lord Dundonald, to a "British Tar Company," and the product of the company was to be made from coal, in such estimation was coal held at that time. If that company were in existence at that moment it would be the most popular, for the English tar was wanted, and wanted badly, but he did not come forward. He was not going into politics, but he might say that, although a standing army was a good thing, England's safety lay in the "silver streak," and no foreign power, with the sea for a base, could do her any great harm. It was upon the sea that England rested her claim as the foremost nation, although those present had seen the greatest sight since man fought his fellow-man, and that was a large army fed every day with the proper rations—a fact that only the German mind could have carried out. In conclusion, Lord Dudley referred to the pleasure it gave him to meet the Iron and Steel Institute, and trusted the visit would always be remembered on both sides with good feeling. (Hear, hear.)—Mr. FOTHERGILL, M.P., proposed, "Success to the South Staffordshire Iron Trade," coupling with the toast the name of Mr. J. P. Hunt. He said that 20 years ago it would have been deemed the most idiotic folly for an ironmaster of one district to have met another and proposed to exchange ideas. (Laughter.) Lord Dudley had, however, told him an anecdote as to the primitive ironmasters who dared not stand up to say anything about their business without their left and right hand supporters standing up with them to prevent someone stabbing them under the arm with a dagger. Yet there he stood, with Lord Dudley on one side and Mr. Fisher Smith on the other, and yet he was not afraid, although they knew that the agent frequently had more zeal than the master. (Loud laughter.) When at Wednesbury Oak he must confess he had never seen such puddled bars, and at Round Oak he had never seen such flat plates. But he must also confess that at Tipton he had seen no plates, and at Round Oak he had seen no puddled bars.—Mr. J. P. HUNT briefly responded, and the visitors proceeded by special train to the Silurian Caverns, which were splendidly illuminated for the occasion. Upon leaving the Dudley Castle grounds, the Mayor of Bolton thanked Lord Dudley for his liberality and kindness, to which his lordship said his greatest satisfaction lay in gratifying his visitors.

THURSDAY.—The members, according to programme, were requested to make their own arrangements for visiting the works in Birmingham or South Staffordshire, as specified in the list. Mr. H. J. Harding, of the Birmingham Exchange, had consented to afford any information that might be required.

THE NORTHERN IRONMASTERS AND THE MINING ENGINEERS, AND THE LOCAL MINE AGENTS.—Also during Thursday the Middlesborough ironmasters and the Northern Mining Engineers paid a return visit to the members of the South Staffordshire and East Worcestershire Institute of Mining Engineers, who at one time visited Middlesborough upon the invitation of the gentlemen thereabouts. In the morning a considerable party was entertained at breakfast at the Dudley Arms Hotel, Dudley. The entertainment was provided by the Earl of Dudley. After breakfast the party proceeded in conveyances to Cox's Rough, Columnar Basaltic Quarry, where a very good view of the South Staffordshire part of the Black Country can be obtained from an elevation of about 700 ft. above sea level. Thence to Mr. Minton's new sinking, which is nearly at the summit of Rowley range. Here Mr. Minton has discovered the Thick coal at a depth of 275 yards, lying under the basalt. Thence they proceeded to Turner's Hill, where a very good view was obtained of the East Worcestershire side of the Black Country. The company then went down the Earl of Dudley's Ramrod Hall Colliery Thick coal pit, under the guidance of Mr. Wm. North, the mining engineer of the pit. This is the largest and best Thick coal pit in East Staffordshire. The party left the Ramrod pits and passed through the Netherton Tunnel from the Withymoor end by steam yacht and boats, under the guidance of Mr. J. Hancox. This grand piece of canal engineering is 1 mile 5 furlongs 140 yards in length, and has a towing-path on each side, and the water-way is sufficiently wide for three boats abreast, and cost upwards of 200,000*l*. It is continually lighted with gas, but on this occasion was lighted from end to end. This tunnel passes through the Rowley basaltic range of hills, and connects the east and west sides of the district; and, strangely enough, no basalt was met with in its construction. At 2 P.M. the party arrived at Messrs. Dixon and Burns' limestone pit, at Dudley Port, where the party descended and took luncheon in the pit, provided by the proprietors. They afterwards proceeded to inspect the extensive limestone workings, which were illuminated for the occasion. The party was under the guidance of Mr. Bristow and Mr. David Peacock, the manager and mining engineer of the company. At about 4 P.M. the party left the pit, in time to proceed by trains from the Dudley Port station, which was within two minutes' walk of the pit, in time for the banquet at Birmingham at 6·15.

In the Lecture Hall, Dudley, there were not many exhibits shown. Mr. E. B. Marten sent a model of South Staffordshire, showing the variations in the surface, with the railway lines and canals marked, and the whole divided into cubes, showing the mines beneath. The model had been prepared for mine drainage purposes. It gave the visitors an excellent birds'-eye view on a small scale of the district. Mr. Marten also showed his instructive cases of models of recent boiler explosions. Winby's Patent Reversible Rail was exhibited. Messrs. Thomson and Co., of the Railway Foundry, Normanton, showed sections of rails, having Bessemer steel tops, dovetailed on iron, and puddled steel tops, dovetailed on iron. Patent wrought-iron tubes, made by machinery at the Imperial Gas Tube Works of John Brotherton and Co., Wolverhampton, were shown, and attracted much notice. It required only little examination to satisfy the visitor that these fittings were considerably superior to hand-made goods. The great strength which the bracket in the weld gives them seems to promise entire freedom from leaking or blowing. The principle is adapted to all kinds of fittings, and the steam fittings possess the further attraction of being some 25 per cent. cheaper than the hand-made goods; at the same time that, like the fittings for gas and water, they are perhaps three times the strength of the hand-made article. We believe that, so far as the exhibit relates to the elbows, the inventor only completed it as recently as Thursday last week. He is now the owner of three patents, by which the leading principle of steam-made fittings are secured to him. He informs us that there is a great demand for the goods, and that a large firm in America are in treaty for the use of the machines upon royalty.

VISIT OF THE IRON AND STEEL INSTITUTE TO SHROPSHIRE—No. III.

The members of this Institute proceeded by special train to visit the Shropshire Ironworks. On arriving at Hollinswood, by the Great Western Company's line, they were met by the representatives of the Lilleshall Company, and one of the company's engines being coupled to the carriages the party were conveyed direct to the Prior's Lee furnaces, and through the Prior's Lee Colliery district to the Lodge, or Donnington Wood Field, thence to the mills, forges, and engine shops. These extensive works occupy the entire angle of the coal field marked on the Ordnance Map north-east of Watling Street, together with a portion in the Prior's Lee district south-west of that line. Of late years, however, the company have extended their works beyond the arbitrary lines which bound the coal field, and have sunk through the red rocks which lie to the east. A better idea, perhaps, of the extent of their operations may be given by saying that they embrace the whole of the mining ground lying between the London and North-Western and Great Western lines of railway, branching off near Wellington and a base line supposed to be drawn from Shiffnal to Lilleshall Hill. This would include a large portion of the mines in reserve, comprised in the 7000 acres leased from Lord Stafford and the Duke of Sutherland, in addition to their own freehold of 400 acres. The great Lightmoor Fault running through the entire coal field divides it into longitudinal portions, and passes through the field, causing a difference of level in some places of 450 feet—a difference so great that no attempts to get the mines to the east as it approaches Lilleshall Hill were made till a few years ago. But the most important collieries now are those on the east or deep side of it, where the red and purple rocks of the Permians overlap the coal measures. The first attempt to sink in the new ground was made in 1860, when the two Granville shafts, 10 ft. in diameter, one a winding and the other a water pit, were carried down to the Fungus coal, the Stone coal, Top coal, Double coal, and Yard coal, the former 306 yards deep and 3 ft. 4 in. thick, and the latter of the same thickness, but 47 yards lower down. The two winding-engines are placed between the pits; one is a vertical 32-in. cylinder, 5-ft. stroke, non-condensing, 40-lbs. pressure, acting direct up to the drum-shaft. Flat wire-ropes are used, one band raising the Fungus coal from the depth of 306 yards and the other the Top coal, 339 yards; but a swamp fault, as we understood from Mr. Horton, has been met with in the Top coal to the east, to the supposed extent of 600 ft. or more, and it has not been followed further. This may turn out, it is thought, to prove its limit in that direction, and to mark the commencement of the estuary of denudation on that side; if so, the other coals lower down may be expected to terminate one after the other in the same way. There is a furnace in the bottom of one of the pits for ventilation, producing a circulation of about 35,000 cubic feet per minute for both shafts.

The Grange pits come next in point of importance, and also in point of time, being the second venture this enterprising company made outside the boundaries of the old field. They were sunk in 1864 to the Fungus coal, and were then carried down to the Randle and Clod coals, which are here only divided by a band, or parting, of 6 in., and are, therefore, worked together as one seam. The pumping-engine, which is placed directly over the water pit, has a cylinder of 40 in., a 9-ft. stroke, and two sets of pumps to raise the top water, the lower water being tubbed out at night. The Stafford pits, the third venture made by the company, and being nearer to the borders of the supposed estuary, all the coals above the double coal were gone, and even this was missing, or partially so, at one of the three shafts sunk. The coals worked, therefore, are the Clod and Randle coals, which, as in the Grange, came together, and from one workable seam at a depth of 250 yards: 200 tons of coal per day are brought to the surface on two-decked cages, and tilted upon an iron incline, sorted and pitched into wagons waiting beneath to receive it.

The engines employed in working these and other deep mines are among the most beautiful polished specimens of machinery we have seen; they are the company's own make, and they seem to perform their work with ease and efficiency. They are 75-horse power each, and the one winds 200 tons of coal per day, whilst the other pumps 96,000 gallons of water in the 24 hours. In addition to the pumping-engines already named, there is a 61-inch double-acting condensing engine at Waxhills, pumping from the depth of 300 yards; one lifting and four forcing sets, varying from 11 to 14 inches diameter; also a 52-inch beam-engine at Muxton Bridge, and seven water-engines at Prior's Lee.

The Woodhouse Colliery is next in importance; but whilst the Double coal is 339 yards at the Granville pit, it is only 250 at these pits. Like the other, these shafts are 10 ft. in diameter, and worked with double bands of flat wire-ropes, and two-decked cages, running on wood conductors, and raising 200 tons per day.

In the Prior's Lee district there are ten pairs of pits, in the Donnington Wood district twenty-one pairs, and in the Hadley Field nine pairs. The magnitude of the company's operations may be better understood by stating that the coal and slack raised amounts to 432,000 tons per annum, the ironstone raised and purchased to 120,000 tons, and the debris in connection with the latter from 600,000 to 700,000 tons per annum.

Between the Woodhouse Colliery and the Granville, Grange, and Stafford Collieries runs the great Lightmoor fault, previously alluded to, which accounts for the difference of the depth to the same seams on either side; and direct east of the latter works is the great East fault, or Valley of Denudation, still more formidable, and more to be dreaded, than the Lightmoor one, as the measures disappear at an easy angle, such as may represent an old coast line, or that of an estuary. The machinery everywhere employed is of the most improved construction, and railways are seen running in all directions through the field, connecting the collieries with the furnaces, these with the engine-sheds, uniting each with the other, and all with the Great Western Railway on the south, with the London and North-Western on the north, and with the Shropshire Union Canals on the north-west. The blast-furnaces, or huge cones, constructed for the purpose of melting down the ores are nine in number, eight of which are in blast; and the average make is 1400 tons each per week. At the Lodge an additional 20 ft. of brickwork has been added to the necks of these great crucibles, raising them to 70 ft. in height, thereby effecting considerable economy in heat and fuel. They are kept in operation by a pair of blowing giants, built upon the model of those so much admired in the Exhibition of 1862. The steam cylinders are 40 inches, and the blowing cylinders 86 inches in diameter. The engines have a 8½-ft. stroke, and the steam-pressure is 35 lbs., cut off at one-fourth of the stroke, and working high-pressure. There are six boilers, two tubes to each. A portion of the coke is prepared in ovens, of which there are 50, and in which small coal or slack is utilised; it is first washed, and the coke upon being withdrawn is also watered by perforated pipes. These calcining kilns, 40 feet in height and 26 feet in diameter, cased with iron plates, are used to prepare the ore, which is raised to the top by an inclined plane, and by means of a small engine.

At Prior's Lee we were informed that the company intend shortly to remodel the whole of the plant, and to erect calcining kilns on a larger scale than even those at the Lodge furnaces. At present, however, the same economy as at the Lodge is observable in the use of slack for coking, and in calcining the ores; here also the materials are raised by a small engine and a vertical lift. Steam is raised by means of the waste gas conducted from the top of one of the furnaces, which are 50 ft. high, to the double-tubed boilers of the engine, which is 400-horse power. The proprietors make altogether much more than a third of the iron made in the county, hot and cold-blast included, for which they have a greater variety of ores at command than any other firm. Their superior cold-blast iron is made from an equal mixture of blackstone, ballstone, blue flats, and pennystone. Of the former each underground acre yields, we are told, 1500 tons, of the third about 1600 tons, the fourth, including the bottom pennystone, upwards of 3000 tons. In addition to these the company have (or had, for the seam is nearly worked out) the command of the Chance pennystone, also the ragged robins, the brick measure, the yellow stone, and the white flats, all of which are used, we believe, with about 20 per cent. of hematite and other ores in making hot-blast iron. The ores differ in quality as they differ in thickness and in depth in different portions of the field, and great practical as well as scientific knowledge is required in dealing with them. The activity, industry, and prosperity of the works appear to be the result of hard-won experience and knowledge, both of which are, of course, needed, to take advantage of the different ores and varying circumstances of the field.

And now, having followed the materials from the gloom of ages to the light of day, from the pit to the smelting furnaces, we enter the forges and engine-sheds, to see by cunning manipulations the metal converted into objects of use or beauty. Here are rolling-mills where the iron is pressed out into the shapes required by rapidly revolving cylinders of immense power; white-hot and elastic it is caught with long tongs and passed and repassed till it comes out a broad flat plate, fit for an iron-clad, or a long square bar, to be used or cut up for other purposes. In the machine shop are 65 planing, turning, boring, slotting, shaping, drilling, and slot-drilling machines. There are also large fitting and erecting shops, used for the making of locomotives and engines of all kinds. Here we found large pumping-engines, with 72-in. cylinders, for the Birmingham Waterworks Company. These engines will have a stroke of 11 ft. We also observed a pair of winding-engines for the Forest of Dean. The company are also just completing the Nettlefold and Chamberlain rolling-mill, and the Siemens' regenerating gas furnaces, which are the first of the kind here, and will be a great novelty in the neighbourhood. It may be doubted whether Tubal Cain, although his name still stands out in relief as one of the first instructors of metal workers, ever dreamt of the uses to which iron, the baser of the series of metals within his knowledge, is here applied. With great facilities of manufacture, with no less resources of capital, and with the aid, at the same time, of a talented staff of servants, the Lilleshall Company set themselves out on a large scale to meet demands which the recent adaptations of iron to the purposes of civilised life are opening up.

VISIT TO TIPTON AND WOLVERHAMPTON.

At the conclusion of the proceedings in the Public Hall, Dudley, the members of the Institute were taken by special train, *via* London and North-Western Railway, to Princes End. From the station at this place they proceeded to the Church School-rooms, Gospel Oak, where a sumptuous luncheon was provided. Mr. Walter Williams presided, and at the conclusion of the repast he proposed "Success to the Iron and Steel Institute," and on behalf of the South Staffordshire ironmasters he gave the members of the Institute a hearty welcome to this district. He said the ironmasters in South Staffordshire could not teach them much, but they would be able to show them blast-furnaces which had been in existence and in use for upwards of half a century. He was sure both he and his colleagues in the trade were exceedingly proud to meet them, and would be happy to show them all they could, and if they wanted to see the conservative principle on which the trade in South Staffordshire was conducted they must go and look at their works. The great aim of the ironmasters in this district had always been to keep up the quality of their iron. (Hear, hear.) In conclusion, he again gave the visitors a hearty welcome, and said so long as the South Staffordshire iron trade existed they should be glad on any occasion to see their northern brethren amongst them. (Applause.)

Mr. I. LOWTHIAN BELL, on behalf of the gentlemen from the North, briefly acknowledged the compliment, and concluded by calling upon both the South and North Staffordshire ironmasters to drink the health of their foreign visitors.

The toast was heartily received, and was responded to by Senor JOSS A. DE YBARRA, who addressed the company in French.

Mr. BESSEMER proposed "The Health of Mr. Walter Williams," and said how much such meetings as these tended to create a good feeling between the members of the trade in all parts of the country, dissipate all petty jealousies, and bind them all more closely together for the furtherance of their mutual interests. (Hear, hear.)

The company then broke up, and dividing themselves into parties visited the different works in Tipton and the surrounding neighbourhood. Amongst the various works visited were the following:—Messrs. Barrows and Sons, Bloomfield; P. Williams and Sons, Wednesbury Oak; the Gospel Oak Iron Company, Gospel Oak; and W. Millington and Co., Summerhill. At half-past four o'clock the majority of the members re-entered their special train, which was in waiting at the Princes End Station, and were conveyed to Wolverhampton, where they visited the Ironworks of Messrs. G. B. Thorneycroft and Co., and the Chillington Ironworks, belonging to Messrs. G. J. Barker and Co. The ordinary operations were going on at all the works visited, and the members showed a keen and practical interest in inspecting the various improvements introduced, and also in examining into and criticising the modes in which the smelting, puddling, and rolling of iron are carried out, different in some of the works in the practice adopted in the North.

The following works in Wolverhampton and Bilston were thrown open to members any time during the meeting:—

WOLVERHAMPTON.—W. Ward and Son, New Priestfield; Osier Bed Iron Company, Osier Bed Ironworks; Fletcher, Solly, and Urwick, Willenhall; Chillington Iron Company, Chillington and Leabrook; E. T. Wright, Monmore Green; Osier Bed Iron Company, Horsley Works, Monmore Green; G. B. Thorneycroft and Company, Shrubbery and Swan Gardens.

BILSTON.—Bilston Brook Furnace Company, Bilston Brook; Barbor's Field Iron Company, Barbor's Field; H. B. Whitehouse, Priorfields; S. Groscott and Sons, Bank Fields and Bradley; W. Rose, Batman's Hill; W. and J. S. Spaross and Co., Bilston Mill and Stowe Heath; Thompson, Hatton, and Co., Bradley Tin-Plate; Stephen Thomson, Bradley; D. Jones and Sons, Bridge and Hebert's Park; Bilston Iron Company, Stonefield; Morewood and Co., Ettingshall; J. S. and T. Turley, Coseley.

THE HEMATITE PIG-IRON MANUFACTURE.

SIR,—The increasing use of Bessemer steel gives even more importance to the question of the manufacture of hematite pig-iron than it would otherwise possess, for it is admitted that it is most valuable for the manufacture of steel rails. Under these circumstances I may be permitted briefly to refer to the very interesting paper on the Askam Works, and the trade connected with them, read before the Institute of Mechanical Engineers at Middlesborough, by Mr. William Crossley. There can be no doubt that at these works, which were designed and erected by Mr. C. T. Clarke, C.E., every modern improvement has been introduced, and the excellent quality of iron ore used facilitates the production of good metal. The ore is shown by analysis to contain upwards of 58 per cent. of metallic iron, the figures being—peroxide of iron, 83 per cent.; silica, 15; carbonate of lime, a trace; and moisture, 1½=100. The silica, it will be seen, is not mixed with alumina, and as it thus becomes necessary to add aluminous ores to produce a better slag, the percentage of silica in the iron can be controlled almost to a nicety. The aluminous ores are mostly Irish, and contain from 25 to 72 per cent. of oxide of iron.

As to flux, the Stainton limestone used seems all that could be desired: it contains—carbonate of lime, 94; carbonate of magnesia, 4·20; oxide of iron and alumina, 0·30; and silica, 0·50=100. The coke, again, could contribute nothing objectionable to the manufactured pig: it is almost entirely obtained from the Durham coal field, and is usually of the best quality. It usually contains about 5 per cent. of ash, and less than ¾ per cent. of sulphur. The result of the working of the Askam No. 2 furnace, of 67 ft. height, 19 ft. in diameter, and 13,100 cubic feet capacity, has been found to be a consumption of 22¾ cwt. of coke per ton of iron made, when working Bessemer iron and using the Askam ore, mixed with about 10 per cent. of black nodular ironstone, and fluxed with 9½ cwt. of limestone per ton of iron made. The average temperature of the blast, during a considerable period of observation, was 934° Fahr., and that of the escaping gases at the furnace top about 712° Fahr. The weight of the escaping gases is 120 cwt. per ton of iron made, and the quantity of heat carried off by them when escaping at the temperature of 733° Fahr. amounts consequently to 21,920 cwt. Fahr. unit, one such unit being the quantity of heat required to raise 1 cwt. of water through 1° of temperature Fahr. The weight of blast supplied to the furnace is 92 cwt., which, at the temperature of 268° Fahr., introduces into the furnace 20,760 units of heat; this is in the proportion of about 95 per cent. of the heat that is carried off the escape gases. The composition of the Bessemer and forge iron made in the furnace is excellent, containing 93½ per cent. of iron, with 2¼ per cent. of silicon, 0·012 per cent. of phosphorus, and 0·004 per cent. of sulphur, and the latter 94½ per cent. of iron, with 1½ per cent.

silicon, 0·031 of sulphur and 0·016 of phosphorus. Less than 2 per per cent. of iron is left in the slags. METAL.

THE ROYAL SCHOOL OF MINES.

TO THE EDITOR OF THE TIMES.

SIR,—From the letter of "Y." the public will learn with surprise and, when better informed, with alarm that the only school which we possess in this country competent to afford instruction in the science of mining is in danger of being "submerged in what is designated a General Science School" at South Kensington; while the collections and illustrations of geology, mining, and metallurgy, which form most important elements in teaching, are to remain behind. The Royal School of Mines in Jermyn-street is really and truly the only school where the application of physical and chemical science is special, and where the arts of mining and metallurgy are taught as sciences formed, according to Sir J. Herschel, on the experience, not of one man only, or of one generation, but the accumulated experience of all mankind registered in books or recorded by tradition, and methodically digested and arranged so as to become the property of one. The collection of specimens and models are special, as they ought to be. The school is, in short, "a chip of the old block"—*i.e.*, of the Royal School of Mines of Freiberg, in Saxony, founded by Werner in 1766. The importance of that school is shown by the increase which has been found necessary in the number of its professors and teachors—from 4 to 15—and for the obvious reason that each branch of the application of science to mining has been made more and more special, in obedience to the law of the subdivision of labour.

For example, there are at Freiberg professors—1, of mine surveying; 2, of mining operations, including (*a*) exploration, (*b*) winning, (*c*) masonry and timbering of mines, (*d*) machines used in mines, and (*e*) machines used in dressing ores and preparing coals for different uses; 3, mining mechanics—viz., the application of pure mechanics to the investigation of the principles of the proportions and efficiency of machines. Again, in metallurgy, there is—1, a professor of metallurgy in general; 2, a professor of the metallurgy of iron; 3, a teacher of assaying; and, 4, a teacher of blowpipe analysis.

I mention these details with a view to show that in a country where education in mining founded on the experience of a century is carried to the highest perfection, and is most widely spread (for there are eight great schools of mines in Germany and Austria, and one in Hungary), the specialising of the subjects taught is the principle of progress and usefulness, and corroborating forcibly the opinion of the "Memorialists," that to smother and extinguish the School of Mines in Jermyn-street by removing it to South Kensington would not only be highly impolitic, but would be, in fact, a retrogression in the order of instruction.

I add that in Berlin the new School of Mines has been quite separated from the other schools of applied science, that the Mining School at Klausthal, in the Hartz, has become a Royal School of Mines under the Prussian *regime*, and the branches of metallurgy and mining are removed from the Polytechnic School of Hanover, that they may be more completely taught than they have hitherto been; and that in the magnificent new Polytechnic School at Aix-la-Chapelle, opened last year, instruction in mining and metallurgy are rendered special, while the preparative courses are relegated to the Polytechnic School of Hanover. I venture thus to offer an opinion from much personal familiarity with, and knowledge of, these important subjects, and from personal acquaintance with the Professors in this country, in Germany, and in Hungary. To the importance of retaining a school specially devoted to mining I should be glad, with your kind permission, again to recur.

LEWIS GORDON,
Emeritus Regius Professor of Civil Engineering and Mechanics in the University of Glasgow, formerly Student of the Royal School of Mines of Freiberg, F.R.S.E., F.G.S., &c.

WASTE COAL.

SIR,—Our attention has been called to a letter signed "Porter and Lane, Fenchurch-street," having reference to a communication of the preceding day from Admiral Cochrane. As the letter above referred to appears likely to mislead the public, we have the pleasure to inform you that it was at our works here that the experiments alluded to by the Admiral were conducted. J. T. B. PORTER AND CO.

Lincoln, Aug. 23.

UTILISATION OF WASTE COAL.

SIR,—As we have been carrying on a series of experiments over six years, will you permit us to say we have at last arrived at a commercial success in bringing the small coal into a fuel, and that under the most severe tests on a large commercial scale? The trial of coal as against coal made into fuel is not only equal to the block of the same description, but 16 cwts. of fuel will do the work of a ton of coal. It will stand any amount of exposure, heat or frost, and wet. We should not trouble you with this letter, but as it is in due course of being brought before the general public we thought you might permit us in fairness to say as much; and, from the eminent authorities on the coal question who have approved the process and the fuel, we may fairly claim to have dealt in a commercial way with one of the questions of the day—what to do with the waste small coal.

Coleford, Aug. 25. LUCKES, NASH, AND CO.

UTILISATION OF WASTE COAL.

SIR,—The great national importance of the question raised by Admiral Cochrane, as to the best means of utilising the accumulation of coal dust for the manufacture or gas, was our sufficient reason for putting forward a method of much more comprehensive scope than that which he suggested. Far from desiring to claim any share in Mr. Silverthorne's experiments in the retrograde direction of conforming by an expensive preparatory process to the exigencies of the primitive, cumbrous, and wasteful system of retorts in common use, our researches have been entirely in the opposite direction, starting upon the first principles indicated long ago by no less an authority than Mr. Clegg, who prescribed the reduction of coal to the divided state of coal dust previous to distilling it in retorts continuously fed by mechanical means.

The mechanical difficulty which formed the bar at that time, and deferred the practical realisation of Mr. Clegg's scientific suggestions, exists no longer. In the system which we advocate, and which we have practised progressively for some years past in several private works, we can now offer a simple and efficient means (equally applicable on a large or small scale) of using coal dust, the so-called waste coal, as the most desirable material for the manufacture of gas.

In conclusion, we may add that we are entitled to speak from the same professional platform as "Mr. A. Silverthorne, C.E.," though as denoting the speciality of our present practice we elect to subscribe ourselves— PORTER AND LANE, Gas Engineers.

Fenchurch-street, Aug. 26.

THE COAL SUPPLY.

SIR,—The Commissioners appointed to enquire into the coal supply of the United Kingdom have issued their report, which, on the face of it, appears satisfactory; at any rate, as regards the quantity of coal still unwrought; yet I venture to think their enquiry did not extend far enough, as I do not imagine that anyone ever seriously thought that the time would come when we in this country would not have coal to supply our household requirements.

For the present I will accept their figures and general statistics as correct, although in a subsequent letter I think I can prove their various calculations to be too sanguine, and the depth at which they assume coal to be workable as open to very grave doubts. Labour in this country costs us at least twice, if not three times, as much as any other nation in Europe, and is continually on the rise; and, consequently, cheap and good coal becomes to us, as a manufacturing nation, a most important, if not absolutely essential, item, if we are to compete successfully, as hitherto, with the foreign markets of Europe. The Commissioners have measured all seams of coal of the thickness of 12 in. and upwards, and to a depth of 4000 ft. they make a grand total of 146,480,000,000 of tons of coal still to work. Now, Sir, presuming I am correct in stating good and cheap coal to be an essential to our national prosperity, I say this enquiry ought to have extended to the probable cost of working these various seams. A bed of coal only 1 or 2 feet in thickness will cost considerably more per ton to get than a thicker seam. Again, a colliery which has to sink a great depth to its coal, requires a very considerable outlay, and as the expense of putting down a new plant will be very heavy, the underground workings will naturally be carried out a long way; and as the temperature of the mine with the additional depth will be very high, the ventilation will have to be more perfect and elaborate, and the air-roads in the workings kept much larger than is necessary at the present average depths. This will all add to the cost of working the coal, and such a colliery could not possibly compete with our existing collieries, or sell coal at present prices. Competition in coal is very keen, and it is a well-known fact that very few collieries are even now paying interest on expended capital, and yet, with all this we can hardly hold our own with foreign markets.

Again, Sir, as to the quality of the various seams of coal. The Commissioners say nothing upon this head, but they measure all alike, and give us a grand total very pleasant to contemplate; yet I venture to think this also a most important matter. In every coal field many of the seams of coal are very inferior; in fact, at present prices worthless, and it is a grave question if many of these seams will ever be of any great value, and as there is no doubt as to the fact that 1 ton of good coal will do more work and go considerably further than the same quantity of inferior coal, it ought to have entered into their calculation as to the probable consumption and duration of our coal fields even at the rate of our present manufacturing requirements.

Again, the best and thickest seams of coal will naturally be wrought first, since upon the quality of the coal depends its demand. This in time will only leave us (at anything like a moderate depth) thin and inferior beds to work, and it is impossible to say how much these even may be damaged and rendered valueless by the subsidence and crushing that must occur in the working of other and thicker seams below them.

These are facts which present themselves to a practised miner, and which militate greatly against the report of the Commissioners, but these, with your permission, I reserve for a future letter. Taking, however, as the basis of my arguments that not only good but cheap coal is essential to our commercial prosperity, I maintain that the wrong issue has been placed before the country, and that the important question is, not the number of tons of coal still unworked, but how long will the present price of coal continue, in what ratio will it rise, and what effect will the rise have upon our manufactures?

I think, Sir, with all deference, that the Commissioners ought to have enquired into these points, and also that our Government should be very careful to prevent waste, for the day is not far distant when all the best seams of coal at moderate depths will be worked out, or our collieries fall into the hands of a comparatively few large proprietors, who, I doubt not, will only be too happy to combine to raise considerably the present price of coal. MINING ENGINEER.

MINING IN PRUSSIA.

SIR,—The rapid and unfortunate climax which has been reached in less than a year in the matter of the Phœnix Mine, near Overath, and the utter want of any confirmation of the brilliant prospects held out to the public in the prospectus of that company, and in the letters appearing in the *Mining Journal* at about the same time, is another proof of the credulity of English capitalists in respect to the opinions of "home authorities," and of the losses to which they expose themselves by blind reliance on the statements of men who, however talented in their proper sphere, cannot possibly be reliable guides in matters so far out of their regular and appertaining fields of action.

The Phœnix Mines were offered likewise to me, in the early part of last year; and, being unable at the time to survey them myself, I secured the services of an English mining captain resident on this side, and in proximate vicinity to the mines. This gentleman—Capt. Z. Walls, of the Leopold von Buch Mine, near Bensberg—after carefully going into the matter, and informing himself at the same time as to its past history (which, from considerable local acquaintance he was easily able to do), and by no means allowing his opinion to be distorted by the small but thoroughly isolated lead ore deposit so temptingly laid open, strongly advised me, despite the much lower price asked for the mine, to decline negociations. It is hardly necessary, therefore, to say that had the opinion of men located in the neighbourhood been solicited this heavy loss to English capitalists would have been avoided. Unfortunately, the case in point is not an isolated one, and that, too, from the same general cause—indiscriminate selection, foreign reporting, and improper management; whilst when these causes are avoided results of a totally different nature attend upon mining in Prussia.

The Wildberg Mines, whilst under the management of a captain of considerable local acquaintance, was a success. The Louise Mines were especially so under like conditions, and is so still under native management. The Leopold von Buch Mine, near Bensberg, still wholly in English hands, has long done well, and is still in active and paying work. These, however, are thus far almost the only examples having had, or still being under, English management, which can or could have been called at any time successes, whilst numbers of the opposite class might easily be cited. On the other hand, native, and even Belgian and French, mining is exceedingly successful and prosperous, in proof of which it only requires to refer to the Bensberg district, within which mines of European celebrity have grown up under careful and considerate management. Not many years since the greater number, if not the whole, of the now best mines of this district were in the hands of English capitalists, or under English management. Success was not their lot at that time, whereas at present the profits from the small area thus designated is scarcely under 30,000*l.* to 40,000*l.* per annum, or from 15 to 20 per cent. upon the total capital invested.

With mining laws, such as exist in Prussia, royalties at less than 2 per cent. of gross value of produce, mining properties granted in perpetuity, cheap and plentiful labour, low price materials, excellent market for produce, first-class communications, and machinery of every kind, of the best and most advanced systems, for ore-dressing, &c., the result of mining in Prussia to the English capitalist ought to, and certainly can, be very different from the generality of their enterprises hitherto. Such, however, will not be the case if English capitalists fail to recognise the value of long years of experience gained in the country, and continue, as heretofore, in introducing outside elements in way of governing the selection of mines, and in controlling their exploitation. ANGLO-GERMAN.

Cologne, Aug. 28.

AMERICAN MINING "EXPERTS"—THE VALUE OF THEIR OPINION.

SIR,—I have read in the *Mining Journal* of July 22 a letter from a person signing himself "Mining Tourist," on the above subject. To those acquainted with mining matters on the Pacific Coast there can be little or no doubt to whom your correspondent refers. I, therefore, feel it my duty to take exception to what he says of the "young man whose experience has been gained among the quartz mines of California," and to affirm from my own personal knowledge that the said "Californian Expert" is one of the few reliable and trustworthy mining engineers on that coast. Educated at Freiberg, he ought to have some experience, both theoretical and practical, with regard to silver-lead ores and limestone formations. It remains to be seen whether his "unfavourable report upon a mine in another territory" will not, after all, prove true, and certainly the opinion of most of those who are acquainted with the said property confirms the view taken by him in his report.

I beg to deny the statement of your correspondent that "this expert is attached to a body whose aim is to prevent, if possible, any mine being purchased except through its agency." I have now known him for two years, and in the course of many conversations with him on the subject of the sale of Pacific Slope mines in England he has expressed far different views, being anxious to see these properties placed on the English market when *bona fide*. He is undoubtedly antagonistic to the numerous speculators who are endeavouring to sell to the British public the refuse mines of California, Nevada, and Utah, and I take it your correspondent is one of this class whose ire he has excited.

If the British public would be more particular as to the status of the men they employ to report upon mines on the Pacific Slope, and to endorse the statements of the vendors, engaging the services of men like Mr. Ashburner and Mr. Henry Janin, of San Francisco, whose honesty and integrity are undoubted, it would be all the better for their pockets, and also for the interest of the owners of the really good mines.

The subscribers to the stock of the North Star Mine and the present holders of the Sierra Buttes shares can testify to what I say regarding the above Californian "experts."

There are undoubtedly many fine and valuable mines in California, Nevada, and Utah, notably the Emma, in the latter territory, as the consignees of its ore in Liverpool can bear witness, which are well worthy the attention of English capitalists; but great care should be exercised in the choice of the mines, and less confidence placed in the statements of the vendors. The latter generally obtain for them in England four or five times the sum for which they are "bonded" to the speculators who took them over. Could these mines be purchased for anything like the price at which the miners sell them they would prove very profitable investments, and give much more satisfaction than they are at present likely to do.

AN ENGLISHMAN.

MINING IN WHITE PINE, NEVADA.

SIR,—Your correspondent who signed himself "P.," in the Supplement to last week's Journal, is one of those croakers who write down certain stocks without reason, and when possessed of a sufficient number of shares write them up again, and the silly people who listen to them find too late what simpletons they have been. Witness Eberhardt mining shares—false reports have depressed them 10*l.* or 12*l.* per share; when light is once more thrown on them the sellers are again buyers at enhanced prices. South Aurora shares are now down to one-fourth of their real value from similar causes, and will as surely rise when the foolish fears of the shareholders are again allayed. I could mention many others of a like nature, but these are enough. If it be of any service to the shareholders to know my experience they are welcome to it. I have visited and been a resident of the district in which these mines are situated, and have been an eye-witness to all that goes on there—and so convinced am I that these mines are of immense value that I have purchased all the shares I could pay for, and, what is more, mean to keep them in spite of all the allurements of the markets. I have no hesitation in saying that the South Aurora will ere long pay 50 per cent., and the Eberhardt 100 per cent. There are other companies started there, which will not bear the closest investigation—of these it is not my business to speak; but I do advise the holders of South Aurora, Eberhardt, Great Western, Mineral Hill, and some others to hold on their shares, and on no account sacrifice a valuable and fast-increasing property, and allow it to become the property of these land sharks who prey upon their fears.

You shall hear from me again from the other side of the water, and I will gather a few facts from friends in America that will, I hope, be of service to my co-shareholders. I am intimately acquainted with miners who have worked these mines since their commencement, and from actual observations I can vouch for the truth of the statements.—*Ringroad, near Bristol.* AMERICAN CAPTAIN.

EMIGRATION AND MINING—1835 TO 1840 VERSUS 1871.

SIR,—The true wealth of a nation consists of the *abundance* of its healthy and vigorous, yet virtuous, inhabitants, able and willing to do their share of the nation's work, all modern political economy to the contrary notwithstanding. It is possible that a country may become over-populated; but, doubtless, this has never yet happened in the history of nations; it certainly is not our case at the present moment. Virtuous mankind, not material wealth, constitutes the true riches of a community; this being so, it is difficult to conceive how mankind can be multiplied to superabundance. As to the Mother Country, there is ample work to be done, both of a remunerative and healthy character; there are also active brains, clear heads, and strong hands to perform it; then why is it not done? Why, through emigration, does the skilled artizan leave the land of his forefathers, as it is said that "rats" leave a doomed and sinking ship? We must not forget that emigration has hitherto drafted off only the most able and enterprising of our inhabitants, and for the most part the active, vigorous, and best of our youth and young men. It should also be remembered that, as a rule, emigration takes off no criminals, no paupers, no sick, no infirm, no lunatics, nor drunkards, but, leaving all these behind, they act as an incubus on the progress and growth of others, and materially lowers the average standard of our national character.

We are led to the above remarks in consequence of the emigration of miners and active labourers from Cornwall to Australia, New Zealand, Canada, Nevada, California, Brazils, the Cape, and even India. The getting in of this year's harvest has been a source of difficulty and increased expense to the farmer in the West, and the price of labour yields the miner nigh on double the consideration that was paid in Cornwall in the years 1835 to 1840, whilst the work effected is lessened in volume, and of a less practical nature. There is also an indifference to conduct and character manifested that is distressing to the executive of mines beyond what the relative position of master and servant justifies—*i. e.*, labour is scarce, and it is not to create surprise that when the telegraph conveys the value of important points to the London dealers hourly, through bribery and corruption to the labourer, or more seriously to be deprecated, submersion of duty to profit in the executive, that legitimate mining lies prostrate, whilst speculative and gambling dealings flourish. There is more money spent in telegraphy by the dealers in shares in Cornish and Devon mines than all the profits which accrue upon the capital embarked. This tax on nature, industry, and legitimate gains is wholly imposed through speculative gambling dealers.

At the period 1835 to 1840 Cornwall was rich in mines both of copper and tin, yet an average standard of 100 to a produce of 7½ per cent. copper was considered satisfactory, and proved to be remunerative to the shareholders. At that date we had Tresavean paying dividends of 100*l.* per share two-monthly; Consols in Gwennap, Dolcoath, Carn Brea, Botallack, Levant, East Rose, Par Consols, St. Ives Consols, Fowey Consols, Wheal Trenwith, West Jewell, Jewell, East Pool, East Crofty, and North Roskear, with Friendship in Devonshire. And also pray let us ask what was the cost of labour at that period, in contrast with the present day? In 1835 and 1840 the tut-work-man's average earnings was from 2*l.* 2s. 6d. to 2*l.* 7s. 6d. per month, whilst at the present day it is from 4*l.* to 4*l.* 5s., and even 4*l.* 10s. per month; and all this is to be attributed to emigration, whilst the drafting off of our best and most able-bodied men has lowered the standard of our supply labour market.

In the years 1835 to 1840, and up to 1845, the chief agents and authorities associated with mining in Cornwall deemed monthly reports all but superfluous, as lodes without changes, chicks, and varied yield, were regarded as of little value, in comparison with those that exhibited these evidences of Nature's handiwork in the collection of mineral deposits. Yet at this very moment the intelligent manager of a mine is satisfied of the progress of development, and is rather pleased when a leader has fallen in, and that the same evidence of a continuation of the deposit of mineral is established as in the level above. Yet the telegraph states that a "fault" is in the end, and that the lode is cut out; in fact, the very evidence in the opinion of the practical authority that confirms success is turned to adverse and profitable account by the London jobber, and the property falls 20 per cent. in market price, whilst 5 per cent. intrinsic worth ought to be added to it.

At the time (1835 to 1840) referred to, the accepted authorities of the day deemed four years' purchase of dividends a fair price for a determined and ascertained paying property; and a shareholder who realised in a progressive mine was deemed to show the white feather, and was ever regarded by his co-adventurers as deficient in speculative adventure, whilst the man who had staked his all, or so much as circumstances would justify, was regarded as a trump, and allowed to retire from the proprietorship with *eclat*, and recouped his proportion of the plant, materials, ores broken, and assets in hand at the date of his surrender. Times, however, change the aspect of affairs. Mines now sell at 10 to 15, 20, and even more years' purchase of di-

vidends, whilst progressive mines are valued more by the parties connected with the company as shareholders, directors, and dealers in the Stock Exchange, than discoveries of mineral made, returns of ores to market, or contingent chances of early or remote dividends; as for example, East Van, 15,000 shares, sells at 14*l.* each (say) 210,000*l.*; yet Wheal Lucy sells for 4000*l.*; South Crofty, under 20,000*l.*; North Roskear, 12,500*l.*; Carn Brea, 140,000*l.*; and Tincroft under 300,000*l.*, paying 40,000*l.* annually.

In conclusion, the fly-wheel of our delicate machinery has been literally broken to pieces, and for some years past there has been no proper regulating force to guide operations of jobbers or brokers in their dealings in either British or foreign mines. Yet we have sound mines at home, well worthy the attention of the investing public. There are mines of lead, as for instance, Minera, Lisburne, and Bronfloyd; of tin, as for example, Dolcoath, Providence, Great Vor, East Pool, West Frances, Botallack, Wheal Owles, Margaret, Tincroft, Cook's Kitchen, and Carn Brea, with many others equally deserving; together with sound progressive concerns, that embody the true elements of success, and shares in which can be purchased at absurdly low prices, and which, from inherent worth, promise at no distant day to become market favourites, and to sell at 100 to 200 per cent. advance in current worth.

R. TREDINNICK,
Crown-court, Threadneedle-street. Consulting Mining Engineer.

MINERS' WAGES.

SIR,—I am glad to find that the interest of the labouring miner is engaging some share of consideration amongst the leading adventurers. Inasmuch as *labour* is the *substratum* of wealth, this consideration is due to the miner, and ought to have been given earlier. I refer to the subject of *payment*. I have for many years considered it a great injustice to require a miner, on entering a mine, to work eight or nine weeks before paying him any wages. This has been the rule, and a very *bad* one it is. In all other departments of labour (out of mines) workmen are paid weekly or fortnightly—generally *weekly*. Why should miners, who are usually very poor men, wait longer than mechanics in other departments? I know that miners are *contractors* ("*tutwork* men" and "*tributers*"), but the agents can always tell nearly how much is due to them for work *done*, and they will take care to see that the adventurers are kept harmless. I think, with Mr. Boyns, that because of the contract system, the payments within the month must be by what is called *subsist*. Then let them all have subsist, if they wish it, and in a *five* weeks' month advance them more, if it can be done safely, than in a four weeks' month Forty years ago, in many of the mines, the payment of "subsist" was made to all the underground men.

I do not charge the mining companies or their agents with *intentional* severity to the miner, but with a thoughtless adherence to a rule which should no longer continue.

The more frequent or *earlier* payments to miners will be of advantage to *shopkeepers* as well as to themselves, inasmuch as it will reduce, if not terminate, the monthly *credit* system, which in many cases has resulted in *bad debts*. Shopkeepers have been co-adventurers, so to speak, with the miners, by whose death, migration, and emigration, great losses have accrued. I know in one case a young woman lost 39*l.* by a miner, who went on month after month increasing his debt till it rose to those figures; he then left the shop, and would pay no more.—*Truro, Aug.* 26. R. SYMONS.

SOUTH CONDURROW MINE.

SIR,—Your correspondent, "Ozokerit," in the Supplements to the Journal of August 19 and 26, has so fairly put the question of accounts, &c., before the public that it admits of little comment or dispute. It is true that the cost is behind, and which may be still further increased by the addition to the floors, stamps, &c.—so that if the accounts are charged up as in the best-conducted mines a deficiency may be shown at the next meeting, and no dividend whatever be justified.

Great stress has been laid upon the additional quantity of tin which is to be forthcoming when the new heads are at work. Query—Will the extra heads make up the quantity? The rich bunch of tin having fallen off, as I see from last week's report, there is no reference to 200*l.* per fathom, but that 80*l.* is the maximum, and that there appears to be an unusual number of men working just about this rich spot; and from last sale (Aug. 17) I find that 13 tons 17 cwts. 10 lbs. of tin were sold for 1091*l.* 0s. 6d. for two weeks, and that the costs amount to more than 2000*l.* per month. That the lower levels contain a large quantity of low-priced tinstuff may be a fact, but inspectors say it is so poor that even at the present high price of tin no profit is likely to result from it. Notwithstanding the tin supposed to be sold to pay the dividend last time the balance in hand was reduced by 100*l.*, leaving 5: 8*l.* 1s. 10d. to be carried forward, instead of 649*l.* 13s. Had it not been for this doubtful sale of tin the balance would have been 334*l.* 7s. 8d. against the mine, and no dividend declared. If, then, this tin has been since delivered the present four months' returns have most unjustly and unusually been charged 878*l.* 4s., for the benefit of those in the secret, and a fictitious representation made which no subsequent results could justify. Many of my clients bought shares through me at 3½, 4½, and have been induced to realise at about present prices, from the conviction on my mind that they were right in securing a very good profit where prospective dividends are problematical.—*Crown Chambers, Threadneedle-street.* JOHN R. PIKE.

CHIVERTON MOOR MINE, AND ITS MANAGEMENT.

SIR,—In reply to a letter signed by "A Constant Reader," we cannot allow the statement therein contained to pass in silence. It is quite evident that we are well known to your correspondent, and are surprised that the bad management should have been placed on our shoulders, when the agents and purser have all to do with the buying, selling, and working the mine. The accounts as sent to us in London are carefully examined by the committee and ourselves, and believed to be the true statements as represented in the cost-sheets sent up by the purser, when cheques are signed for whatever amount is required for the pay, and sent down to the company's representatives; but if those agents do not do their duty to their employers we defy any mine to prosper. Your correspondent refers to our connection with North Roskear. The purser tried to get entire possession of the whole control of the management of this mine between himself and his friends, to whom he could give orders for materials; this he succeeded in doing, consequently the manager was removed. We cannot hold ourselves responsible for the rise or fall of shares, as it must be well known to your "Constant Reader" that it often occurs without any improvement in the mine or its management. WARD AND LITTLEWOOD.

SOUTH DARREN AND GREAT NORTH LAXEY MINES.

SIR,—How is it that the first-named mine, which is returning 500*l.* worth of lead ore per month, besides the sale of at least 400*l.* worth of copper ore each half-year, with good ore in the 50, 60, 70, and 80 fm. levels, with better prospects than ever, does not command that attention which it really deserves? It is situated in the very best of districts, in a line with East Darren and Bronfloyd, about halfway between each. It has paid over 6000*l.* in dividends. Its ore realises from 18*l.* to 19*l.* 10s. per ton. It is in 6000 shares, and they appear wholly neglected, being only worth some 20s. or so each. Some six years ago, before it paid a dividend, shares were 2*l.* 5s. each. With its present very good and apparently certain prospects, with dividends in store, these shares should be firm at 45s. to 50s. each.

Great North Laxey Mine is rapidly becoming a valuable property, selling 30 tons of ore per month, for some 400*l.*, with prospects of very shortly returning quite 40 tons per month. They have better deposits here in depth, and the ore of richer quality as the mine deepens. The reserves are fast increasing, yet the shares are quite neglected, fetching some 10s. to 12s. 6d. each. The lode here worked is the Great Laxey lode, and in all probability Great North Laxey will shortly rival its rich neighbour. The shares in this mine ought to command at least 35s. to 40s. each. The public, however, prefer the gold that apparently glitters, being wild after the numerous Californian mines, and very questionable public companies. But why should these two sterling mines be neglected so entirely, and thus snubbed, when there are mines—lead mines, in 12,000 and 10,000 shares—situate not 100 miles from Pwllheli, Carnarvonshire, though improved and in an untried district, the shares of which command some 3*l.* and 2*l.* each respectively? The public surely ought to be better judges, and look to known good districts for their selections. RESPICE FINEM.

MINING IN CARDIGANSHIRE—BRONFLOYD AND DARREN UNITED.

SIR,—In travelling through the valuable lead mining district between Aberystwith and Machynlleth, I was much struck with the very promising appearance of the lode-stuff then being brought out of the adit level now in course of driving in the above mine. The property is situate between, and apparently in a direct line with, the celebrated Bronfloyd and Darren Mines—the same or parallel productive lodes must certainly exist in the Bronfloyd and Darren United—and from what can now be seen in this property certain success is not far distant, as by the continuation of the present adit level only about 15 fms. to 20 fms. further there will be from 40 to 50 fms. of backs to stope away, and which will gradually increase as the level is extended. Little or no machinery being required to develope the property to a great depth augments its intrinsic value, and should the lode now wrought continue to improve some thousands of tons of argentiferous galena may be raised from the backs of the adit levels. I find, also, in following up the dingle towards Machynlleth, and about 100 yards only from the spot where the men are now engaged driving the deep adit level, another large sparry lode is plainly to be seen, and, judging from its longitudinal course, will converge with the one now being wrought on at no very great distance beyond their present working, and to reach this point appears to be the object of the proprietors, as in nine cases out of ten where such junctions exist abundance of mineral is found. I, therefore, advise capitalists to keep an eye on this property, which I am informed is at present wrought by a few private individuals, and to take an interest in the undertaking without delay if shares are obtainable. There are other properties in and around this district that will I believe ultimately turn up prizes; but seeing the Bronfloyd and Darren United possessing the chance of speedily becoming such induces me to make these remarks for the guidance and benefit of mining speculators.

Aberystwith, Aug. 26. AN UNINTERESTED BUT PRACTICAL MINER.

MINING IN IRELAND—THE CARYSFORT MINES.

SIR,—Having seen in the Journal of Aug. 19 a paragraph referring to the Carysfort Mines, I beg to say that your correspondent is quite correct in speaking of the financial difficulties with which the recent manegement had to contend. There are on the property many points of the greatest promise situated on the course of the great lodes of the district, which, from want of funds, were necessarily left unproved. With respect to the late management, on which your correspondent presses somewhat unfairly, it is simply justice to say that the energy and judgment used, and the efforts made on very narrow means, were highly approved and appreciated by the directory, and that this view has been confirmed by the expressed opinion of the most eminent mining authorities. FAIR PLAY.

THE CEFN CONSOLS LEAD MINING COMPANY.

SIR,—With reference to the letters which appeared in the Journal on Aug. 19 and 26, about this mine and its management, I beg to state that the writers thereof had an opportunity of stating their grievances at the general meeting of the shareholders, which was held here yesterday, but they failed to put in an appearance thereat. It is true that the notice convening the meeting stated that it would be held only *pro forma*, and be adjourned to Oct. 30, in order to give time for the development of two points in the workings, from which good results are expected, but of course it was quite competent for any shareholder to raise a discussion at this meeting upon any question affecting the company, and it is remarkable that shareholders having the opinions expressed in the letters referred to should not have attended and supported their statements.

The directors decline to enter into any controversy through the medium of the Journal or any other paper, but being perfectly satisfied that all their acts have been for the benefit of their co-shareholders, that the mine is legitimately being developed, and that the money subscribed has been judiciously expended, they will be happy to show any shareholders all the books and documents of the company on calling at this office.

I may add that in future Captain Ellis's monthly report on the mine will be forwarded to you for insertion in the Journal. THOMAS R. COMYN, Sec.
Threadneedle-street, Sept. 1.

THE VIRTUOUS LADY—THE KING—THE QUEEN.

SIR,—I had hoped that when some months ago Mr. T. J. Barnard announced that he would cease to trouble the readers of the Journal with any more of his productions that he really meant what he said, and that we should have had no more of his flowery statements with respect to his Virtuous Lady and the King and Queen Mines. He forgets the old adage that "Good wine needs no bush," and in his publication last week of the report of Capt. Pascoe and his own agent, which are all fair enough, there would have been no cause to complain if he had omitted his own embellishments and predictions. Mr. Barnard appears to have been very unlucky in his prophecies, as it cannot be denied that his Virtuous Lady Mine, which was to have paid 20,000*l.* in 1870 by way of dividend, has not as yet returned a single shilling to his equally unlucky shareholders, and from all I can learn the prospect of any return is quite as remote as when the mine commenced working.

The Queen Mine, it is true, paid two quarterly dividends of 1s. per share, but I failed at the time to satisfy myself that they were paid out of legitimate profits, and the mere fact that the capital had to be increased by the issue of new shares to the value of 5000*l.* justifies the inference that any further division, unless out of subscribed capital, is a very long way off indeed. I do not object to Mr. Barnard's calling the public attention to the three properties before mentioned, but when he aspires to the spirit of prophecy he should bear in mind that this gift was only given to the few, and although his faith may be unlimited and undiminished by his notable failures, I would urge upon him the necessity of working his mines in a proper manner, singing their praises less loud, and letting the mines themselves tell their own tale by actual returns and profits, otherwise I fear, like many other celebrities, he will suddenly find his light extinguished, and another fatal blow given to the mining industry of the country.—*London, Aug.* 21. LOOKER-ON.

THE QUEEN MINE, AND ITS PROSPECTS.

SIR,—I regret to be compelled to express my general dissatisfaction with Mr. T. J. Barnard's reply to my letter in the Journal of Aug. 19. One-half of it (the most inconvenient, I presume) he has completely overlooked. Of the peculiar fulness and candour of his replies to the other half I leave to my brother-shareholders, and such of the public as care to do so, to judge. Two years ago it was the "Virtuous Lady" that was to give its "fortunate shareholders" 20,000*l.* annual profits; now it is the "Queen" that is to fulfil our sanguine Secretary's predictions, in the future.—*Aug.* 30. INVESTOR.

SOUTH AURORA MINE.

SIR,—In a circular which I received some time since, in which the South Aurora was recommended as the cheapest investment in the market, at the price of 7*l.* a share, it was stated that the balance of cash to the company's credit at the end of the quarter was 6064*l.* In last week's Journal it appears that the balance of cash now on hand is 4659*l.*, showing a loss of 1405*l.* for the quarter. I should like to know from some of your correspondents when there is a probability of a further dividend.—*Tullamore, Aug.* 29. R. JACKSON.

[For remainder of Original Correspondence see to-day's Journal.]

FOREIGN MINING AND METALLURGY.

Industrial operations are being freely resumed in France, and large orders for iron have been given out. At St. Dizier the last few days have witnessed a considerable improvement in the state of affairs. Some important orders have been received for special iron, and notwithstanding the high prices current the works have orders assured to them for several months in advance. Machine coke-made iron has realised 9*l.* 12s. to 10*l.*; mixed ditto, 10*l.* 8s. to 10*l.* 16s.; and charcoal made ditto, 11*l.* 12s. to 12*l.* per ton. Iron from coke-made pig has been disposed of at 9*l.* to 9*l.* 4s. per ton; ditto from charcoal-made pig at 10*l.* 8s. to 10*l.* 12s. Sheets have been in demand; wire has also been active, at sustained quotations. The insufficiency of rolling stock on the French railways is such that not a fourth of the combustible required has arrived at the works; this circumstance has, of course, occasioned much embarrassment to industrials.

In the French departments of the Nord and the Pas-de-Calais the extraction of coal continues to be carried on upon a great scale, and prices are maintained with firmness. Notwithstanding that praiseworthy efforts are made by the Northern of France Railway Company to respond to the requirements of industry, the complaints of coalowners continue to make themselves heard with reference to the want of means of transport, while the great stations are still blocked up with coal awaiting removal. A statement has been received with general satisfaction to the effect that the Lille and Valenciennes Railway Company has signed with the Minister of Public Works a convention granting a concession of lines from St. Arnaud to the Belgian frontier, in the direction of Blanc-Misseron; and from St. Arnaud to the Belgian frontier, towards Tournai.

At Havre copper has displayed rather less firmness. A fortnight since it made 70*l.* per ton, Paris conditions; but latterly it has only realised 69*l.* 4s. per ton, with comparatively little business passing even at the reduction. At Marseilles, Spanish copper is quoted at 72*l.* per ton; refined Chilian and Peruvian, 76*l.* per ton; rolled red copper in sheets, 82*l.* per ton; ditto in rounds, 86*l.* per ton. The German copper markets have been generally well supported; at Hamburg the article has been in considerable demand, and prices have acquired firmness. The Dutch markets have presented little change. There has been no great amount of business passing upon the French tin markets; at Marseilles, Banca has been quoted at 144*l.* per ton. The German tin markets have been generally firm, although quotations have shown some weakness in Holland and England. At Hamburg, however, tin has been rather neglected. Upon the Dutch markets Banca has been quoted at 79¾ fls., and Billiton at 78½ fls. There have been several arrivals of Billiton during the last few days. At Havre soft Spanish lead, first fusion, has made 18*l.* 16s. to 18*l.* 18s. per ton. At Marseilles lead in saumons, first fusion, has made 17*l.* 6s. per ton; ditto, second fusion, 17*l.*; lead in shot, 20*l.* 8s.; and rolled and in pipes, 20*l.* per ton. At Hamburg no important transactions have been reported in tin. At Rotterdam, Stolberg and Eschweiler have made 11 fls.; and German lead of various marks, 10¾ fls. There is not much change to report in zinc. At Marseilles rolled zinc has brought 28*l.* per ton. In Germany zinc has generally made rather higher rates.

There is very little news to communicate with regard to the Belgian iron trade, which continues in a prosperous condition. Prices remain without variation. In the arrondissement of Charleroi, pig is easily disposed of; the current of orders for special iron is also constantly increasing. Large plates, No. 2, are quoted at 9*l.* 4s.; ditto No. 3, 10*l.*; ditto No. 4, 13*l.* 4s. per ton. The Belgian railway rolling stock establishments are doing their best to obtain orders, which are about to be given out in Germany. The state of the collieries in the Liége basin continues very satisfactory; affairs are well sustained, and the future is full of promise. Commercial relations are being resumed with France, Germany, and certain parts of Holland; coke is more and more in request, and new furnaces are expected to be lighted. Deliveries to the interior are becoming more numerous, but are made very sluggishly; trucks for France are always scarce. In the Mons coal basin the market is quiet, the extraction feeble, and the stock considerable. Rolling stock on the railways in this district continues to make default. Freights have experienced little change. Great activity prevails in the Charleroi basin, where all the workpeople are occupied at good wages. Numerous orders for coal are coming to hand, especially from the sugar manufacturers, who are increasing their supplies in view of the exceptional crop of beetroot. The local consumption leaves nothing to be desired, all the mines, furnaces, glassworks, &c., being actively employed.

The Paris iron market has been very quiet. Orders are not given out very freely, and there appears to be little disposition to accept an advance, which the forgemasters of the Nord recently resolved upon. In the Nord the works are abundantly provided with orders; plates are in such demand that this kind of manufacture may be regarded as overdone. A quotation of 10*l.* 8s. per ton at the forges is currently accepted for ordinary puddled plates. The French construction workshops are actively employed. The house of Merveilles Kling, which has just executed a bridge over the Oise for the Northern of France Railway Company, has concluded some important contracts. At Longwy metallurgical operations are only resumed slowly. The Châtillon and Commentry Forges Company will pay on the 15th inst. a dividend of 1*l.* per share.

FOREIGN MINES.

ST. JOHN DEL REY.—Morro Velho, Aug. 1: Morro Velho produce, second division of July, 12 days, 3765 oits.; yield 2·134 oits. per ton. New shafts sinking in July, A, 1 fm. 3 feet 6 in.; B, 1 fm. 5 feet 3 in. Dynamite arrived July 29, and although a hard layer of rock is met in both shafts, quite average sinking in August is expected.

DON PEDRO.—Mr. F. S. Symons reports, under date July 29: Produce weighed to date, 12,553 oits.; estimate for month, 14,553 oits. The features of the mine continue most promising. General stopes have yielded well, particularly the shoot of lode making below the level, Alice's west; the body has also yielded box work, as also No. 6 rising from horizon of old sump and canoa. Nothing has been excavated from the line in the curve. The level for more effectually draining the northern portion of the mine has progressed well, and good duty accomplished at the adit level, where we are opening on the body of the auriferous lode lately encountered. At the shallow adit the ground, though very wet, has not been unfavourable for tunnelling. The exploratory works are being regularly carried on.

ANGLO-BRAZILIAN.—Mr. F. S. Symons reports, under date July 29: General Operations: Pitangue: Attendance of force fair. A large amount of materials has been sent from Passagem, and the works are being pushed on with vigour. A soft channel of ground has been encountered in Hoskin's level, but is not likely to retard the driving, as immediately I was informed that the ground was becoming troublesome I sent an experienced man from this place, and according to last advice received from there yesterday they had nearly got through it. At the adit level the ground continues hard. The erection of the stamps will be pushed on with all speed. A piece of timber of necessary size for axle has been purchased; arms, rings, and part ironwork for water-wheel have been forwarded from Passagem. At Passagem there is nothing new to advise.

GENERAL BRAZILIAN.—Capt. T. Treloar reports, under date July 28: General Operations: The operations generally are progressing satisfactorily, but at the shallow adit (St. Anna) the water has increased; at present it is not much under 200 cubic feet per minute, but even so about 5 fathoms have been advanced. The old workings above are not yet dry, but they are daining. The weather is very fine, and the health of the establishment all that can be desired; force sufficient, and for the present no more blacks will be taken under contract.

ROSSA GRANDE (Gold).—Mr. Ernest Hilcke reports, under date July 28: The works at the different sections have been carried on with good dispatch during the last fortnight, but nothing has occurred to call for particular notice. At the Cachoeira Mine we discontinued stoping, and have resumed the driving of the adit level. The trial to ascertain the real value of the lode recently intersected in this mine has been made; it will produce, as near as I can estimate—the gold not being quite cleaned up—from 6 to 7 oits. per ton.

SOUTH AURORA (Silver).—A letter from the manager, dated Aug. 6, states: "I ship to-day eight bars bullion, value $9365 55c., making total shipment $42,797 34c. since the 6th ult."—The following is an extract of letter received from the manager, dated Aug. 7:—"A contract has been concluded between Mr. Philpotts, manager of the Eberhardt and Aurora Mines and myself, to crush ore from the mines for 30 days. The price to be paid us is $15 per ton, the ore to be delivered in the mill. I have no doubt we will be able to crush 1500 tons during that time, at an expense of $9 per ton, giving us $6 clear profit. As the South Aurora is not at present producing as much ore as will keep us running steadily, I thought best to take this contract. We have still at the mill about 750 tons of South Aurora ore, and at the mine 250 tons dressed, and about 500 tons to be dressed. Details of the last run will be in my next report, which I shall get ready as soon as possible."

EBERHARDT AND AURORA.—The directors have received 17 bars of silver, valued at 4000*l.*

UTAH (Silver).—The directors have received the following telegram from Captain J. Nancarrow:—"Furnace finally running well. Bullion coming in. All going on well at the mines. Sold first bullion to-day; value at Omaha, $163."

FRONTINO AND BOLIVIA (Gold).—The directors have received advices by the West India Mail from their superintendent, Mr. Rouch, under date July 12, accompanied by a remittance of 825*l.* of gold dust, the produce of the Frontino and Bolivia Mines for the month ending June 20.

TAQUARIL (Gold).—Mr. T. S. Treloar, July 28: No change worthy of mention has taken place in the mine since my last. Explorations on the hill adjoining the stamps are progressing, and auriferous samples continue to be derived, but to date we have met with nothing better than what was advised by last mail. The produce, judging from appearance of Tacho, will be equal to, if not in excess of, that for June.

PACIFIC.—A telegram from Mr. H. Sewell, the manager: Crushing 50 tons, produced $10,200.

ALMADA AND TIRITO (Silver).—Under date July 13, the manager, Mr. Clemes, advises net profit for June, 562*l.* Owing to the unprecedentedly dry season, the the 30-head stamps have only been able to work two or three days per week. The annual festival, which takes place about ten miles from the mines, together with a strike amongst the workmen, have been the cause of the above small return; but the strike is now at an end, and without any concession having been granted. The rainy season has commenced, water is again plentiful, and Mr. Clemes states that labour is coming in rapidly now the holiday is over. There is a large quantity of ore raised and ready for stamping when cleaned. The above difficulties being now overcome, the monthly profits after July will doubtless be much higher.

UNITED MEXICAN.—Extract of despatch from Mr. Edward Hay, dated Guanaxuato, July 23: Mine of Jesus Maria-y-José: In the frente de Santiago the ore is very irregular in its ley, but the quantity extracted from the lower part of the vein has helped to make up for its deficiency in value. I have, however, to report that the quarters' accounts ending June 30 show an excess of expenditure over returns of $5041. In the first two weeks in July the ore extracted by buscones was of a better ley, and there was also a good deal of competition between the purchasers. The last torta ground in Dolores assayed about seven marcs per monton, or about 38½ ozs. per ton, and in Duran the same increase of ley has taken place. It is to be hoped that the ore will continue of this ley.—Mine of Remedios: A new frente, called San Pedro, was opened over Santa Isabel, in which they are driving to the north, to cut the bunch of ore that was met with below on San Crescensio and San Cristobal; the end looks promising. In Santa Isabel we had hitherto met with little success, the ore having been rather poor and scarce, but now the frente has improved, and perhaps we may get better ore from it. San Crescensio north is still the labour from which we get the best part of the ore; the other workings are very much the same as before.—New Concern, Adit of San Cayetano and Mine of Buenos Ayres: The hilo (thread of ore) I spoke of in my letter of July 2 still continues, and in the last few days has become broader; from a width of scarcely 1 in. it has now increased to about 6 in., and has taken a downward direction. The hilo is composed of shining quartz, and is besprinkled with pyrites. The ramaleo (network of quartz rock, &c.) continues, but the rock is dry. In the new cross-cut to the south, which we began a fortnight ago, the work has been going on steadily. Its direction is south, 16° west, and we have driven about four varas in the aforesaid direction. All the attle (rubbish) has been carried out of the adit, and we can now cart out what is knocked down without any impediment.—Mine of San Antonio de la Ovejera: The hilo spoken of in previous reports as continuing to run in a more easterly direction has this last week turned off to the right; for the remainder nothing but pure rock.—Mine of San Cayetano de la Ovejera: The strip of ore on the surface some buscones had been working on did not turn out as profitable as was expected. The net produce of the ore sold was $33, therefore it covered the outlay, and so far it is a satisfactory result.

[For remainder of Foreign Mines see to-day's Journal.]

AN EXTRAORDINARY GOLD MINE.—At the Caledonian Reef, at the Thames Gold Field, in New Zealand, the extraordinary dividend of 75,000*l.* was realised in 14 days, and paid to the shareholders; and so far as could be judged, there was no appearance of the find decreasing. The exact quantity of gold realised by crushing, completed on Saturday, May 27, had never been equalled by any two quartz mines in the world within a like period. The result of the last retort of the day in question increased the total amount of melted gold to 25,000 ozs. 6 dwts., or considerably over 1 ton of gold from 560 tons of quartz crushed during that time; and, although every bit of amalgam was restored to make up the yield, the whole of the specimens taken out had not been put through. The greatest excitement prevailed at the Thames Gold Field.—*Sydney Advertiser.*

ANTIMONY MINES IN AMERICA.—Mr. A. Harnickell, informs us that he has had the Battle Mountain Mines and smelting works examined and worked; found that he can produce pure regulus at 3 cents per pound, and pay a dividend of 50 to 100 per cent. per annum on a capital stock of $100,000. Mr. Harnickell has found that the supply of cheaply mined ore is sufficient to last for centuries, and that nowhere else in the world does it occur as rich and pure as in those mines, being nearly pure tersulphide and teroxide of antimony, with a trace of bismuth and silver, to which a cheap process of smelting and refining has been adapted, rendering the cost of production cheaper than that of lead.—*Iron Age* (U.S).

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